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INTERNATIONAL EDUCATION SERIES

MEMORY

WHAT IT IS AND HOW TO IMPROVE IT

BY

DAVID KAY, F. R. G. S.

AUTHOR OF "EDUCATION AND EDUCATORS," ETC.

NEW YORK
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1889

EDITOR'S PREFACE.

There is no topic in educational psychology more important than that of memory and its cultivation. Memory is indispensable in all intellectual processes, and therefore must be trained and developed. But it is liable to prove destructive to the other faculties (so called) and supplant them; hence it must be restrained within its proper limits, made auxiliary to the other faculties, and not allowed to assume the chief *rôle*. It is a matter of every-day comment that much memorizing deadens the power of thought—verbal or statistical memory being "mechanical." But it is also equally true that memory may paralyze the powers of sense-perception, imagination, and will. With an overactive memory we suppose ourselves to see in an object what we remember to have seen in it before, and any new features escape our superficial perception. This is true, too, in the case of imagination, the power which ought to be productive as well as reproductive, and by which we ought to envisage not only real objects but possible ones, and thereby sharpen our powers of invention and discovery. Even the imagination may be dulled by a too active memory, and degenerate into a mirror of the

past. The productive imagination should belong not only to poets and artists, but to all men, as a faculty of discovering ideals and emancipating us from the imperfect reality. It should give us a tendency to invention and to aspiration. But, under the weight of prescribed forms and the sway of memory, a civilization crushes out self-activity on the part of individuals and imposes the *rôle* of external authority upon all. Thus the will of the individual loses freedom, and settles down into passive obedience to custom and prescription.

The important question to determine is the proper amount of memory-cultivation. The Chinese education fills the memory with maxims of Confucius and Mencius, and the individual follows these because there is little else in his mind: their lines are graven so deep that nothing else seems important.

The antidote for this baneful effect of memory is to be sought in a method of training that associates effects with causes, and individuals with species; that associates one idea with another through its essential relations, and not by its accidental properties. One must put thought into the act of memory.

Memory is not one faculty, so to speak, but a condition of activity of all faculties. There is one memory of places, another memory of the names of places; one memory of persons, and another memory of names of persons; still another memory of dates; another of principles and causes; and so on. The cultivation of one species of memory may assist or it may hinder another kind of memory, according as the mental activity by which the attention is fixed on one subject aids or hinders the mental activity of the other kind of memory.

"Hence," says Mr. Kay (page 13), "we may cultivate the memory for persons without at all improving that for places, and a good memory for colors may afford little help toward the remembrance of forms." On the other hand, the memory of names assists the memory of persons, and that of places assists that of forms.

The cases are rare in which a person has a weak memory in all directions.

In considering the question of improving the memory, therefore, the individual must ask in what respect he is defective; is it dates, or names, or something else that he fails to remember? Moreover, it is necessary to ask whether it is important to remember those items that he forgets so easily—whether, in short, it is worth while to acquire a habit of remembering them. For instance, as children we remembered village gossip, personal remarks, actions, or things and events, that are so trivial that we do not permit ourselves now to interest ourselves in them or recall them. Do we not find, in fact, our memories of those insipid things and events of childhood still too vivid? We are apt to speak of children, for this very reason, as having strong memories. But would we willingly have again our childish memories? Would it content us to notice trivial circumstances and overlook essential matters? If so, it is easy to gratify our desire by cultivating the childish form of memory. We may give our attention to the accidental features of an event, to the details of trivial gossip, and neglect the main issues and the causal processes. It will naturally result, then, that we shall remember as children remember, with the difference that we shall find ourselves able

to do a far greater amount of superficial observation and recollection than children can do.

Attention is regarded as the condition of memory (see Chapter VII). Attention implies a selection of a small province of the field before us, and a neglect of the rest. Hence the training of attention implies also a cultivation of neglect. As we grow mature in our intellectual power we increase in our ability to seize the objects of our choice and to pass over without notice all others. The person without a well-developed power of attention is in a state of passivity toward invading external influences. He is a prey to impressions that come from his environment. Most of these "early impressions," of which we hear so much, were received at a time when trivial things could seize upon us and absorb our powers of observation to the neglect of more essential things. Such passive impressibility, the condition of the childish memory, it is the object of education to eradicate. The pupil must learn to exclude and ignore the many things before him, and to concentrate all his powers of mind on the one chosen subject. Mr. Kay truly remarks (page 259), "It is as one is able to shut out every other object, every other idea, even self, from the mind that he attains the highest degree of mental power."

It follows that the discipline of attention makes the memory uneven or unequal. The study of relations weakens our memory of mere isolated data. The study of general ideas causes us to be careless in regard to specific details that naturally follow as effects. Our insight into laws weakens our hold of special instances. Knowing the law of eclipses, we can calculate all past

and all future instances, and we do not care to burden our memory with the historical record of eclipses. Our attention to the meaning of a word weakens our memory of its sound; attention to a person's character makes us less careful to remember his costume.

While, therefore, it is a correct educational maxim that the memory must be trained on essential relations and causal processes so as to strengthen the power of thought at the same time, yet there may be excess even in this direction. We find, accordingly, people whose memory of dates is so defective as to cause much waste of power; other persons are so forgetful of names as to be under constant embarrassment in conversation or in writing.

It is a reasonable thing to correct special defects in the lower orders of memory when they become matters of serious embarrassment. Those special powers of memory should in that case be strengthened. It is a perception of this necessity that has led to systems of mnemonics. The common device of such systems has been association of the items of one province of memory with those of another. The items easily forgotten are fastened, so to speak, to items easily remembered—names or dates, for example, to places or events. As it often happens that the items of one order are not related to the other order by the principle of causality or genetic development, it happens that the mnemonic association by which memory of a particular kind is to be strengthened, is merely an accidental relation of the items associated. Contiguity of space or accidental resemblance in sound is to assist us to remember. By mnemonics we cultivate a habit of consciously seeking

such accidental relations, and we accordingly injure our power of logical thought by neglecting essential for unessential relations. Our author (page 281) condemns such mnemonic devices severely—"The wrong association of ideas in the mind is a source of endless mischief,"—and quotes Locke as saying: "The connection in our minds of ideas, in themselves loose and independent of one another, has such an influence and is of so great force to set us wrong in our actions, as well moral and natural, passions, reasonings, and notions themselves, that perhaps there is not any one thing that deserves more to be looked after."

An example of this wrong method: Gregor von Feinaigle's "New Art of Memory" (London, 1812) says that "the recollection of ideas is assisted by associating some idea of relation between them; and as we find by experience that whatever is ludicrous is calculated to make a strong impression upon the mind, the more ridiculous the association is the better." Think of an effort of the mind to discover absurd and ridiculous relations between ideas with a view to remember them! That were to cultivate memory at the expense of sane, rational thought.

The true method of cultivating and strengthening a defective memory is to practice it on the kind of items that it easily forgets. A few such items must be memorized and reviewed daily, adding a small increment to the list as soon as it has become perfectly mastered. A list with fifty items thus memorized will suffice to develop a habit of attention to such items and a power of recalling them, which will grow steadily with such exercise as circumstances bring occasion for.

A personal example may be related. The writer, when in his eighteenth year, was embarrassed by the feebleness of his memory for dates. He commenced learning a list of the dates of accession of English kings—William the Conqueror in 1066, William Rufus in 1087, etc.—three or four dates the first day; two new ones added the second day; one new one added the third day; thereafter less often. Constant review by-and-by made the entire list familiar. It had to be learned anew a year after, and once again after some years of neglect. But the memory for dates grew steadily, and, without conscious effort, dates and numbers soon came to be seized with a firmer grasp than before. This kind of memory still increases with the writer from year to year, and, although it is not by any means a phenomenal memory, it is very serviceable.

A similar cultivation of the special memory for proper names (which in the writer's case had become very weak and threatened to go altogether) has proved serviceable.

The special kind of memory that is weak should be cultivated by itself and not attached to some other form of memory. The simile of a magnet is to the point here. Load it to-day with iron filings, and to-morrow it will support a few more. The memory, if only strong enough to retain a single item with effort, will grow stronger by the effort, and will soon retain two items, and finally others in vast numbers and without effort.

By this method we avoid fantastic associations and correct the weak faculty itself, instead of fastening its work on another faculty. Let the exercise be a list of dates valuable to retain for themselves. Or, if it is

names that one wishes to remember, select a list of important persons that furnish centers of historical information; such, for example, as the names of the Roman emperors, the English and the French kings, the heroes of Plutarch's histories; or of typical personalities, such as the characters in Shakespeare's dramas or in Homer's "Iliad"—items of world-historical importance.

A list of one hundred proper names learned in their order, as kings of France and of England, and the emperors of Rome, will furnish central nuclei to historic material, and the memorizing of such a list, or, indeed, a list half as large, will so discipline the memory for names as to permanently remove all embarrassment from this source. It is not the length of the list, so much as the thoroughness with which it is learned, that develops the memory. It is not well to go on beyond a hundred items, for the reason that such mechanical memory should not be made too strong. Idiots and semi-idiots may show prodigious powers of remembering numbers, and very feeble intellects may be exceptionally apt in remembering names and other words. Therefore, while there should be some special training to strengthen varieties of mechanical memory that have become too weak for the service required of them, they should not be over-cultivated.

Repetition and careful attention should be relied upon more than association in the cultivation of the mechanical varieties of memory, for the reason that association, though more showy and brilliant in its effects than repetition and attention, is not so much a correction of the special province of memory defective as a substitution of another province of memory for the de-

ergy that produces the facts. Each fact is then seen in the perspective of its history, or of its genesis, and thus thoroughly explained; but with such explanation the scaffolding of original facts that were inventoried and systematized falls away, and all observation of new facts in the province becomes a mere verification of the known mode of action of the energy. Agassiz, having learned the principles of biological structure, recognizes a new fish from one of its scales, and can tell with confidence its structure and conditions of living. It is not a matter of memory, but of direct insight. So Cuvier can see the whole animal in one of its bones, and Lyell see in each pebble its entire history. Goethe's allegorical "Homunculus"[1] symbolizes this new achievement in the scientific mind. The little living being confined in a bottle figures the final career of induction which has arrived at insight or intuition. Having exhaustively surveyed its limited field, each special science seizes upon the organizing principle and can predict facts or recognize and explain them at sight. When we can see each immediate fact in the perspective of its genesis or history, we have no use for memory which preserves for us facts and events isolated from their producing and deducing causes. Memory is moribund, and in province after province it is losing its importance. A fact-producing principle is seized and the facts are kept no longer in vast storehouses, for they can be deduced when wanted, or, if encountered in our experience, they can be explained and dismissed. We look beyond them to their causes, and let sense-perception and memory of such facts both drop. The relative

[1] See the "Second Part of Faust."

amount of activity of sense-perception, of memory, and of mere reflection on accidental relations (νοῦς παθητικός), continually diminishes, and the thinking on principles, causes, and organic processes (νοῦς ποιητικός) increases.

William T. Harris.

Concord, Mass., *August, 1888.*

fective one. Memory of places, for example, is substituted vicariously for memory of numbers or names.

The author of this book, Mr. Kay, devotes the first four chapters to a discussion of the physiological side of memory—not, however, with much reference to the recent special researches in physiological psychology.[1] This is just as well, perhaps, for there is nothing strictly physiological thus far discovered that is of much practical value in the educational treatment of memory. Much, it is true, has been located or partially located in the brain and nervous system, and diseases of the memory may with some degree of certainty be connected with accompanying lesions in the brain. But whether these lesions are causes or effects, or both, we are not able to cure an ordinary case of failing memory except by pure psychological means—namely, by attention, mental association, and repetition—doubtless affecting the brain thereby, but through free acts of the will.[2] We can affect the brain through the effort of the will on the memory, but we can not as yet develop the memory through body-culture.

[1] There is no reference, for example, to the labors of Wundt, Waitz, Volkmann, James Ward, Ebbinghaus, Fechner, Meynert, Spitzka, Flourens, Hartwig, or to Ribot's "Diseases of the Memory."

[2] An example of the vagueness and uncertainty of attempted physiological statements of the facts of mind is seen in the case of Herbert Spencer's law (quoted on page 285): "Two ideas will cohere feebly or thoroughly according as the correlative nervous states involve a feeble or a strong discharge along the lines of nervous connection; and hence a large wave of feeling, implying as it does a voluminous discharge in all directions, renders such two ideas more coherent." Compare with this the counter-doctrine of Mr. Kay (on page 299): "Emotion, passion, and other feelings that are of a diffusive nature and affect the brain generally, prevent action along

Aside from this exception (of the more recent authorities) Mr. Kay has everywhere supported his statements by copious quotations from the literature of the subject. More than one thousand well-chosen citations from nearly two hundred authors are given, and the reader may see the drift of past investigation and theory on the subject.

It may be added that Aristotle's profound insight into the nature of the soul and its powers deserves more study. In his "De Anima" that philosopher places memory with the phantasy, the activity of sense-perception, and the discursive intellect, as together constituting the "passive reason" (Νοῦς παθητικός). He considers this part of the soul perishable or moribund. This thought of the perishability of such faculties in the onward career of the soul has quite another and deeper meaning than that usually attributed to it. Memory and sense-perception become less and less prominent factors in the human mind, and in some departments they already occupy a very inferior position. In arithmetic and geometry, for example, we deduce the special instance rather than observe it and memorize it. In each of the natural sciences an epoch of observation closes with an exhaustive inventory of its details, and there follows an epoch in which the whole compass of details is organized into a system by means of a discovery of the laws and modes of action of the organic en-

limited tracts. Hence the apparent antagonism between our feelings and our intellect, the one acting, as it were, in direct opposition to the other; . . . our past feelings are very difficult to recall," etc. Professor Bain also indorses this to the effect that "emotion spurns nice distinctions, and incapacitates the mind for feeling them."

AUTHOR'S PREFACE.

MANY years ago the present author contributed an article on "Mnemonics" to the Eighth Edition of the *Encyclopædia Britannica;* and since that time, as indeed before, the subject of memory has had, for him, a special interest. The more, however, he studied Systems of Mnemonics the less satisfactory did he find them to be. They are all based on imperfect or mistaken views of the true nature of memory; and the striking effects sometimes produced by them are mere tricks of mental association, which do nothing towards the improvement of the higher parts of memory, or its development as a whole. A pretty extensive reading of works on Mental Philosophy threw light on many points connected with this faculty; but it was only when he came to view it in connection with the facts of Physiology that he arrived at what he believes to be a right understanding of it.

Physiology shows the close and intimate connection that subsists between mind and body. From it we learn that every thought that passes through the mind, every sensation we experience, every act we do, produces some definite change in our bodily structure, so that there is reason to believe that there is a particular state of the body corresponding to every state or act of the mind. This change is permanent, and

constitutes in the author's view the physical basis of memory, the type of which may be seen in the scar of a cut finger which remains long after the wound itself is healed, and never wholly disappears. The change so effected is not confined to the brain, but extends to all the parts of the body in which it originally took place.

When one performs a set of movements for the first time, he may find considerable difficulty in doing so, owing to the unadaptedness of the parts concerned. These parts, however, retain certain traces of what has taken place in them, so that when the movements come to be performed a second time, the difficulty attending them is somewhat less; and thus at length, through frequent repetition, what was at first accomplished with difficulty, comes to be performed with the greatest ease. Along with this increased ease, the muscles that have been in action are observed to acquire greater size and firmness,—according to some, in consequence of an increase in size of the existing fibres, but according to others, with more probability, through the growth of new fibres. And as with the muscles so with the senses. The trained sense is capable of apprehending what to the untrained sense is imperceptible, owing to the greater aptitude of the sense-organ through training. Nor can it be held to be different with our intellectual faculties. The trained reasoner readily detects fallacies in an argument, in consequence of the part of the brain where the reasoning faculty has its seat having been developed by exercise. Men act as they have been accustomed to act, they observe best what they have frequently observed, not merely on account of changes effected in the brain, but also in the muscles and organs of sense. The will has by no means that power over our actions, or even our thoughts, that is

commonly supposed. A man cannot at will change his gait, his handwriting, his voice, nor even his modes of thought, simply because the parts concerned in these have developed in the direction in which they have been exercised, and cannot readily act otherwise.

When we recall to mind with any degree of distinctness an act we have previously done, the similarity between this and the original doing of it is so great as to favour the opinion that the same parts are concerned in the one as in the other. When we repeat an act a second time, some traces of the first act remain and render the second more easy; and may we not well suppose that these traces have also something to do in the recollection of it? And as with our actions so with our sensations and thoughts, the changes wrought by them in our bodily structure may well be supposed to be concerned in the recollection of them.

It is the author's opinion, then, that whatever parts are concerned in the production of a sensation, or in effecting a movement, the same parts are necessary to a full and complete recollection of it. Thus, the senses are not only necessary for the receiving of impressions, but are also concerned in the recollection of them, and the muscles are not only requisite for the performance of actions, but are necessary also for the remembrance of them. This is particularly the case in the highest form of memory, the "representative" or "imaginative," where the past impression is recalled with almost all the vividness and distinctness of the original.

Physiologists, however, almost without exception, assert that the brain alone is the seat of the memory. They are shut up to this view from holding that the nerves are capable of conveying impressions only in one direction,—sensory nerves only to the brain, motor nerves only from the brain. Hence, when a

sensation passes from an organ of sense to the brain it is there treasured up for the after use of the memory. According to this view there is no way by which the mind can communicate with the organ of sense, or take cognisance of its condition. A man ignorant of Physiology believes that he feels an object at the points of his fingers, but the Physiologist steps in and says that he can feel it only in his brain, because the nerves of sensation carry impressions only to the brain. According to Sir W. Hamilton, however, "we have no more right to deny that the mind feels at the finger points, as consciousness assures us, than to assert that it thinks exclusively in the brain". "The organ of the mind," says Prof. Bain, "is not the brain by itself: it is the brain, nerves, muscles, organs of sense, viscera."

It was formerly held that nerves conveyed impressions only in one direction owing to a difference in their nature or structure, but this is now found not to be the case, for each class of nerves is capable of conveying impressions in either direction. If the end of a sensory nerve be united with the end of a motor nerve, the excitation of the sensory may be transmitted to the motor fibres, and the reverse. A careful consideration of the subject has led the author to regard each class of nerves as capable of conveying impressions in either direction,—sensory nerves, while primarily afferent, being secondarily efferent, and motor nerves, while primarily efferent, being secondarily afferent. Hence a sensory nerve in sensation is afferent—conveying an impression to the brain, whereas in perception and in recollection it is efferent—conveying an impulse from the brain to the organ of sense. Speaking of a similar view, Prof. M'Kendrick says that it "is quite consistent with all the facts of nervous physiology, and presents

fewer difficulties than the one generally held". (Art. "Physiology," in *Encyclopædia Britannica*, Ninth Edition, 1885.) As strengthening the view that the mind is in connection with all parts of the nervous system, it is to be borne in mind that there is no essential difference between the nervous matter of the brain and that of the numerous ganglia throughout the body, and recent physiological investigations show that the axis cylinder of the nerve fibres is identical with the protoplasmic substance of the nerve cells—the latter being simply "nucleated enlargements of the axial cylinder".

The importance of this doctrine to the view here advocated is that it enables us to explain how the mind can communicate with the organs of sense or the muscles in recalling past sensations or movements. Unless the same parts are concerned in the recalled sensation as were active in the original, it is difficult to see how they should so closely resemble each other. It is well known that if we close our eyes and think intently on a particular colour, the retina becomes exhausted for the reception of that colour, exactly as if we had been actually gazing upon it. The artist who can recall to mind a scene he has once looked upon, so vividly that he can paint it from memory, as if it were actually before his eyes, must be supposed to have the power of again projecting on the retina the impression previously made on it.

Philosophers recognise an essential difference between sensation and perception. In sensation an impression is conveyed inward from an organ of sense to the brain and awakens consciousness; in perception the awakened consciousness goes out, as it were, upon the sensation, distinguishes it from other sensations, and localises it. In the former it is known that an impulse passes from an organ of sense to the brain, and in the latter it

would seem that an impulse passes from the brain to the organ of sense.

Every idea in the mind must have entered it by some sense, and in order to its full and complete recall, it is believed that it must be again projected or imaged in an organ of sense. Even the most abstract of our ideas are abstracts of sensations belonging to some sense, which is also concerned in the recollection of them. In order to think on a subject it is necessary to put it out as it were from the mind. "Thought," says Heyse, "is not even present to the thinker till he has set it forth out of himself." By thus putting forth his ideas they become as it were objects of sense, and doubtless the senses are concerned in them. Thus the senses are not only necessary for the recollection of our sensations, but even of our ideas.

Holding, then, that the seat of the memory is not the brain alone but also the organs of sense and the muscles, it is evident that in order to improve the memory special attention must be given to the training of the senses. This is to be done by first training them to observe carefully what is before them, and then making them recall or reproduce what has been presented to them, as accurately as possible. These two are distinct. The one depends on attention, the other on association, and frequently recalling what is in the mind. In attention the great thing is to concentrate the mind upon one thing at a time till it is thoroughly mastered. In association we must seek to bring together and associate those ideas that most nearly resemble each other, and that we wish to recall each other. By frequently recalling our knowledge, we, as it were, strengthen and facilitate the means of communication between the senses and the brain.

In order that a movement or change in any part of

the body may be taken up and apprehended by the mind, it is necessary that a mental image of it be formed. The mind can take no account of any movements or changes that may be taking place in the body, except in so far as they give rise to mental images, and according to the clearness and accuracy of the image which is formed will be the hold taken of it by the memory. These images, it is believed, have their seat not only in the brain, but, like the memory and the mind itself, embrace also an organ of sense or certain of the muscles.

As it is held that every motion, sensation, and thought leaves its permanent traces in our physical structure, it naturally follows that every thought or impression that has once been consciously before the mind never afterwards entirely passes from it. It may never again come up consciously before the mind, but it will remain in the region of unconsciousness, giving a colour or bias, it may be, to all our after-thoughts and feelings. Hence the most sanguine hopes may be entertained with regard to the possibilities for improving the memory. What an unspeakable advantage it would be to a man if everything that he had ever read, or heard, or seen, or thought, or done, could be so laid up in his mind that he should be able to recall it at any time he might wish to do so; and who shall say that this is impossible? At least there are cases recorded of men having had such memories.

The author has little faith in Arts for improving the memory in two or three lessons, but he has unbounded faith in systems of education, properly conducted, to effect incredible improvements in this direction. Children in their earliest years manifest great power of memory, and they learn to speak and understand their mother-tongue in a very short space of time. This

power is said to be speedily lost, but it may well be questioned whether it is not destroyed by wrong methods of teaching. Whatever the child sees it looks at with its whole mind, whatever it hears its whole mind is bent upon it, but as soon as its education begins all this is changed. It is set to learn the alphabet, and here it has three tasks put before it at once. A letter is presented to its eye which perhaps it has never seen before, and it is expected to form a visual image of it; a sound is addressed to its ear, and an auditory image has to be formed of it, and it is expected to pronounce it all at the same time. Now, if there is any truth in the principles here laid down, they clearly show that a child cannot learn two things at the same time without great loss of power and injury to the parts concerned. If we would observe and follow nature, then, the ear should be first of all accustomed to the sounds of the different letters before seeing them, or even being required to pronounce them. Then, when it is familiar with the sounds of the different letters, let it be taught to pronounce them, and only when it can do this accurately should it be made acquainted with the forms. In like manner, in learning a foreign language, the different sounds should first be mastered by the ear and tongue before the words are presented to the eye. Further remarks on this subject will be found in the last chapter.

It is impossible to over-estimate the importance of this subject as bearing upon education. The whole science of education may be said to be embraced in the question of "How to improve the memory?" It includes not merely the cultivation of the different mental faculties and furnishing them with knowledge, but the training of the senses, and the developing of the various physical powers. Every act in the training or cultiva-

tion of any power or faculty depends on memory; all the habits we form are built up through it. If the author's views on this subject are correct, then the whole system of education as at present conducted is on a wrong basis. Instead of the communication of knowledge being made the means of improving the memory, the interests of the memory are sacrificed in order that it may be crammed with as much knowledge as possible without regard to the permanent injury that may thereby be done to it. It has been the author's endeavour throughout the volume to bring out the practical bearings of his views upon education.

In dealing with this subject the author has found himself in a great measure on unexplored territory. No other writer on Memory or Mnemonics has, so far as he is aware, taken up the same ground.[1] Even the authors he has followed, and to whom he feels deeply

[1] Professor Loisette largely advertises a system of improving the memory, which he calls "The Physiological Art of Never Forgetting". The art is only taught or communicated under a strict promise of secrecy, so that the author has had no means of becoming acquainted with it; but judging from the Prospectus he believes that it proceeds on the same lines as here laid down. It is said to differ from the hitherto taught systems of mnemonics in using none of the "associations," "localities," "links," "pegs," "keys," &c., of the latter; but to be based on physiological principles and to employ nature's own process of remembering,—statements which are likewise applicable to the present system. One of his pupils mentions, as an instance of the advantages he had derived from the system, that at a party he was able to name fifty different articles placed on a table in a private room, after simply taking a deliberate look at each, while none of the others could master more than nineteen. This doubtless he could not have done had it not formed an essential part of his training, and this is exactly the method here recommended. The Professor tells us that he believes his system "is destined to work as great a revolution in educational methods as Harvey's discovery of the circulation of the blood in physiology,"—but it is difficult to see how this is to be effected while it is kept a secret. The author, too, believes that his system will effect great improvements in educational methods, and in order that it may do so, he publishes it without reservation.

indebted for the support they have afforded him, he has frequently had occasion to differ from. While, therefore, he has endeavoured to express his views with all clearness, he trusts he has also done so with modesty knowing how liable one is to err in such circumstances and how little one individual mind can do towards perfecting the knowledge of such a subject, which calls for the combined labour of many minds working in different fields,—in philosophy, in physiology, in education, &c.

LONDON, *January*, 1888.

CONTENTS.

MEMORY.

CHAPTER I.

MEMORY: WHAT IT IS.

"That we should have it in our power to recall past sensations and thoughts, and make them again present, as it were: that a circumstance of our former life should in respect of us be no more, and yet occur to us, from time to time, dressed out in colours so lively as to enable us to examine it, and judge of it as if it were still an object of sense;—these are facts whereof we every day have experience, and which, therefore, we overlook as things of course; but surely nothing is more wonderful or more inexplicable."—*Dr. James Beattie.*

"So necessary and so excellent a faculty is the memory of man that all other abilities of the mind borrow from hence their beauty and perfection. . . . In a word, there is neither knowledge, nor arts, nor sciences without memory; nor can there be any improvement of mankind in virtue, or morals, or the practice of religion without the assistance and influence of this power."—*Dr. Isaac Watts.*

"It seems that we owe to memory almost all that we either have or are; that our ideas and conceptions are its work, and that our every perception, thought, and movement is derived from this source. Memory collects the countless phenomena of our existence into a single whole. . . . Our consciousness would be broken up into as many fragments as we have lived seconds but for the binding and unifying force of memory."—*Dr. E. Hering.*

MEMORY is the most important and wonderful of all our faculties.[1] It is that in each individual which records what is constantly passing in his mind, and treasures it up so that it may afterwards be recalled at will. Sir William Hamilton calls it "the faculty possessed by the mind of preserving what has once been present to consciousness, so that it may again be recalled and represented in consciousness".[2]

[1] Memory is "designated by Kant the most wonderful of the faculties".—*Dr. Pick.*

[2] "It is that faculty which enables us to treasure up and preserve for future use the knowledge we acquire."—*Dugald Stewart.* "Memory is as it were the storehouse of our ideas; for the narrow

Unless the mind possessed the power of treasuring up and recalling its past experiences, no knowledge of any kind could be acquired. If every sensation, thought, or emotion passed entirely from the mind the moment it ceased to be present, then it would be as if it had not been; and it could not be recognised or named should it happen to return.[1] Such an one would not only be without knowledge,—without experience gathered from the past,—but without purpose, aim, or plan regarding the future, for these imply knowledge and require memory. Even voluntary motion or motion for a purpose could have no existence without memory, for memory is involved in every purpose.[2] Not only the learning of the scholar, but the inspiration of the poet, the genius of the painter, the heroism of the warrior, all depend on memory. Nay, even consciousness itself could have no existence without memory, for every act of consciousness involves a change from a past state to a present; and did the past state vanish the moment it was past, there could be no consciousness of change.[3] Memory, therefore, may be said to

mind of man not being capable of having many ideas under view and contemplation at once, it was necessary to have a repository to lay up those ideas which at another time it might make use of."—*John Locke.* "Memory is the magazine in which are deposited the sensations, facts, and ideas, whose different combinations form knowledge."—*Helvetius.*

[1] "The senses give us information of things only as they exist in the present moment; and this information, if it were not preserved by memory, would vanish instantly and leave us as ignorant as if it had never been."—*Dr. T. Reid.*

[2] "All our voluntary powers are of the nature of memory;" and "in morbid affections of the memory the voluntary actions suffer like change and imperfection".—*Dr. D. Hartley.*

[3] "Consciousness supposes memory; and we are only conscious as we are able to connect and contrast one instance of our intellectual existence with another."—*Sir W. Hamilton.* "We could not discriminate two successive impressions if the first did not persist mentally to be contrasted with the second."—*Prof. Bain.*

be involved in all conscious existence—a property of every conscious being.[1]

But while everyone must thus of necessity possess some degree of memory, there are few or none that possess it in that degree that they might and should do.[2] The possessor of a good memory is rare, while persons with weak and unreliable memories are, unfortunately, but too common. They may not be otherwise deficient in natural parts, but their memories are not sufficiently strong for anything to impress them deeply or for any length of time. All the usual impulses to action may be in full force or even in excess, but they lack the wisdom or knowledge necessary in order to act rightly or with a due regard to results. They act usually upon the spur of the moment and are constantly making mistakes. Even the teachings of experience are in a great measure lost upon them from lack of persistence. Such persons are never long in one frame of mind: their joys and griefs, their loves and hates, their purposes and ambitions, are all short-lived. Having no fixed or settled purpose to guide them, they are uncertain in their movements, and their conduct cannot be depended on. In character they are inconstant, flighty, unstable, changeable as the wind, unimpressible as water. They are like the man beholding his face in a glass, of whom we read that "he goeth away and straightway forgetteth what manner of man he was".[3]

[1] "From the Archangel to the brute we conceive that something analogous to an organ of memory must be possessed by each."—*Prof. Drummond.*

[2] "In some persons the mind retains the characters drawn on it like marble, in others like freestone, and in others little better than sand."—*John Locke.*

[3] "When memory is preternaturally defective, experience and

A good memory, then, is a matter of the very highest importance, and no pains should be spared in order to acquire it.[1] Its value consists in this, that it treasures up the experiences we have had in the past, so that we can afterwards recall them at will. We cannot in very deed live over again our past years, we cannot bring back yesterday when it is gone, but by means of memory we can recall the mental impressions which these have produced in us, so that we can examine and judge of them, gather knowledge and experience from them, and even derive a measure of pleasure and satisfaction from their contemplation. Thus while, in a sense, the past when once past is gone for ever, in another it is still present with us, instructing, guiding, warning, encouraging us. It enters very largely into our present existence, constitutes the greater part of our intellectual being, and builds up our personality.[2]

knowledge will be deficient in proportion, and imprudent conduct and absurd opinion are the necessary consequence."—*Dr. Beattie.* "A character . . . retaining a feeble hold of bitter experience or genuine delight, and unable to revive afterwards the impressions of the time, is in reality the victim of an intellectual weakness under the guise of a moral weakness."—*Prof. Bain.*

[1] "To have constantly before us an estimate of the things that affect us, true to the reality, is one precious condition for having our will always stimulated with an accurate reference to our happiness."—*Prof. Bain.* "The thoroughly educated man, in this respect, is he that can carry with him at all times the exact estimate of what he has enjoyed or suffered from every object that has ever affected him, and in case of encounter can present to the enemy as strong a front as if he were under the genuine impression."—*Ditto.* "A full and accurate memory, for pleasure or for pain, is the intellectual basis both of prudence as regards self and sympathy as regards others."—*Ditto.*

[2] "One of the essential requisites of continued existence is the capability of retaining some sort of hold upon the past."—*Prof. Drummond.* "By a mind destitute of the faculty of memory neither the ideas of time, nor of motion, nor of personal identity could possibly have been formed."—*D. Stewart.* "Memory gives us the per-

This constant presentation of the past serves a very important purpose in our mental economy. It throws light upon the present and guides us with regard to the future. Without the past our present ideas would be devoid of all meaning, all intelligibility. It is only as our past ideas and sensations come to interpret and explain our present experiences that we can know or understand them.[1] The sight of a stone, a tree, or a book would convey little meaning to the mind did not memory supply previous impressions of the same kind, which serve to throw light upon it, as the words of a book would be unintelligible did not memory furnish us with the several meanings to be attached to them.[2]

suasion of personal identity during all the changes which may take place in the condition of the body, or in the temper and habits, and external circumstances."—*Isaac Taylor.* "The present state is associated with others which, thrown back and localised in the past, constitute at each moment what we regard as our personality."—*Th. Ribot.*

[1] "This arm-chair, three paces from me, gives my eyes the sensation only of a green patch differently shaded, according to its different parts; still from this simple visual indication (through previous sensations) I conclude that it is solid, soft, with a certain magnitude and form, and that I may rest myself in it."—*H. Taine.*

[2] "It is frequent for men to say that they see words, and notions, and things in reading a book, whereas, in strictness, they see only the characters which suggest words, notions, and things."—*Bishop Berkeley.* "In looking at a page of print or manuscript . . . we seldom recollect that nothing is perceived by the eye but a multitude of black strokes drawn upon white paper, and that it is our own acquired habits which communicate to these strokes the whole of that significancy whereby they are distinguished from the unmeaning scrawling of an infant or a changeling."—*D. Stewart.* Reading "is the memory of the thing signified, incessantly evoked by the graphic sign that causes us to adopt automatically, with each graphic sign perceived by the understanding, ideas of which such signs are but the conventional expression".—*J. Luys.* "Were it not that the steps can be recalled, it would seem absurd to say that when the reader takes in at a glance the sentence 'This is true,' he not only classifies each word with the before known like words, but each letter with the before known like letters."—*H. Spencer.*

But it is as serving to guide and direct our future conduct, to give us judgment, accuracy, and skill in carrying out what we purpose or intend to do, that the value of a good memory is most seen.[1] In regard to any line of conduct or course of action that may lie before us, it is evidently of the greatest importance that we should have present to us, in the mind, the memory of previous actions of the same or a similar kind, for our guidance and direction. If we have pursued one course of conduct and it has turned out wrong, the remembrance of this should lead us to the adoption of a different course the next time, which may, peradventure, turn out right; and, on the other hand, if the course we have previously followed be the right one, the memory of this will not fail to strengthen and encourage us to continue in it, while the effect of each repetition, which is but another form of memory, will be to render each succeeding act more easy and natural than the preceding one.[2]

Much of the pleasure and enjoyment of the present is derived from the memory of the past. "The happiness of our later life," says Professor Bain, "is in great

[1] "The great purpose to which this faculty is subservient is to enable us to collect and to retain for the future regulation of our conduct the results of our past experience."—*D. Stewart.* "If a man of good genius and sagacity could but retain and survey all those numerous, those wise and beautiful ideas at once which had ever passed through his thoughts upon any one subject, how admirably would he be furnished to pass a just judgment about all present objects and occurrences."—*Isaac Watts.*

[2] "After each action it (a muscle) is better prepared for action, more disposed to a repetition of the same work, and readier to practise a given organic process. . . . The organic memory thus formed resembles the psychological memory in all but one point, the absence of consciousness."—*Th. Ribot.* "In every nerve-cell there is memory, and not only so, but there is memory in every organic element of the body."—*Dr. H. Maudsley.*

part made up of the pleasurable memories of early years."[1] As a general rule, the remembrance of past pleasures is pleasant, and, as has been well said, he who imparts an hour's real enjoyment to another increases the sum of his happiness while the memory of it lasts.[2] The dweller in a foreign land often goes back lovingly in thought to the scenes and incidents that in memory cluster round his early home.

Frequently the remembrance of experiences that were not at all pleasant, but disagreeable or painful at the time, become sources of pleasure and satisfaction as they are recalled, from having been productive of good or beneficial results. Thus the prosperous man of business looks back with pleasure on the difficulties and hardships of his early years, by which were instilled into him those principles of carefulness, endurance, and self-reliance that have so greatly contributed to his after success.[3] Nor is the remembrance of pain, suffering, distress always without certain feelings of pleasure, as it presents itself to the mind under other or happier circumstances. Even in the midst of our deepest sorrow for the loss of a much-loved friend there mingles a feeling of pleasure as we recall his

[1] "I always figured age to myself as a much pleasanter season of life than our earlier years, and having attained it, my expectations are almost surpassed."—*W. von Humboldt.*

[2] "In his hour of gloom or despondency, one may yet enjoy as vividly as ever the picture of some past delight, or feed on the memory of a happy moment which, though long perished in fact, can never, by the blessed influence of memory, be lost to him on this side of the grave."—*J. G. Fitch.* "If you make children happy now, you make them happy twenty years hence by the memory of it."—*Sydney Smith.*

[3] "Say why Vespasian loved his Sabine farm?
Why great Navarre, when France and freedom bled,
Sought the low limits of a forest-shed?"
—*Pleasures of Memory.*

many amiable qualities, and we feel how true are the words of the poet: "'Tis better to have loved and lost than never to have loved at all".[1] "I would not," said the great Duke of Ormond, on the death of his only son, "exchange my dead son for any living son in Christendom." Thus, "thanks to a beneficent Creator," says Ancillon, "sorrow loses not only its bitterness but is changed even into a source of pleasing recollection".

The defects of memory of which most persons complain, and with reason, are mainly, if not entirely, to be attributed to the ignorance that prevails regarding its true principles, and to the abuse and neglect to which it is subjected in our systems of education and through life. The office of the memory is to remember, and there can be no doubt that if properly trained and judiciously treated, it will remember to an extent and with a clearness that, with our present conceptions of it, will seem nothing short of marvellous.

In general we take much too limited and confined a view of the memory. We usually confine it to what we can recall or bring to mind when we wish to do so; and if we fail in this we say we have forgotten it, or that it has escaped our memory. But everyone's experience must tell him that there is much in his memory that he cannot recall in this way,—much that he can only recover after a laboured search, or that he may search for in vain at the time, but which may occur to him afterwards, when, perhaps, he is not thinking about it.

[1] "There is a real luxury in grief, because we cannot think of the dear dead without recalling the many joyful incidents of their lives; and thus it often happens that the mourner who is sitting by the coffin which contains all that was dearest to him on earth, wakens up from a reverie in which he was living over again the happiest days of his life."—*Dr. J. Cunningham.*

In seeking to recall a past thought or impression we must still retain something of it in the memory, or we should not be able to recognise it when it presents itself, or to single it out from among a number of other candidates that may be pressing forward for recognition.[1] Indeed, the very fact that we seek in the memory for a forgotten idea shows that we have some recollection of it, for, as St. Augustine very truly says, "We cannot seek in our memory for that of which we have no sort of recollection". "From the moment," says Sir W. Hamilton, "that we seek aught in our memory, we declare by that very act that we have not altogether forgotten it; we still hold of it, as it were, a part, and by this part which we hold, we seek that which we do not hold." In all these cases the memory has a certain hold of the ideas, but they are not sufficiently impressed upon it to be readily or distinctly recalled. In the memories of most, if not all of us, probably the greater part of what we remember is of this imperfect kind.

There are many persons of opinion that there is no such thing as forgetting anything that has once been consciously in the mind. "It is, I believe," says Dr. Carpenter, "the general creed of metaphysicians that no idea once fully comprehended by the mind ever permanently drops out of it; while physiologists are no less strong in the conviction that every act records itself in some change in the brain which may lead to its reproduction before the consciousness at any distance of time." "I feel assured," says De Quincey, "that there is no such thing as ultimate forgetting; traces once impressed

[1] "When we will to remember a thing we must remember something relating to it, which gives us a relative conception of it."—*D. Stewart.* "He who searches for anything has a general notion of that which he seeks, otherwise how could he recognise it when found out?"—*Plato.*

upon the memory are indestructible; a thousand accidents may and will interpose a veil between our present consciousness and the secret inscriptions on the mind. Accidents of the same sort will also rend the veil. But alike, whether veiled or unveiled, the inscription remains for ever."

Between this property of never forgetting anything that has once been in the mind and what we all feel to be the actual state of our memories there is a wide gulf. To explain the nature of this and to show in what it consists will fall to be more fully treated of afterwards. In the meantime we would remark that in memory, as commonly understood, we have two distinct parts or faculties—the retentive and the reproductive; the one being the power of retaining what has once been present to consciousness, the other that by which it is again brought before consciousness in recollection. Though commonly used to include both, the term memory is strictly applicable only to the former of these, or the retentive faculty.[1] This is much more extensive than the reproductive faculty, for we retain or hold in the memory much more than we can at any time recall. That we can readily recall or remember some things and not others depends upon a variety of circumstances, but especially upon the degree of attention that is bestowed upon the original impression. It is evident that if we single out an impression or thought by giving a greater than ordinary degree of attention to it, or what is the same thing, if it strikes us very forcibly or is several times repeated, it will be more deeply

[1] "That the word memory principally and properly denotes the power the mind possesses of retaining hold of the knowledge it has acquired, is generally admitted by philologers, and is not denied by philosophers."—*Sir W. Hamilton.*

impressed upon the mind than it otherwise would be. The bad memories of which most persons have occasion to complain are mainly owing to their not giving that degree of attention to the original impression that is necessary to fix it in the memory.

While attention is the principle by which we fix anything in the memory, association is that by which we recall or bring again before consciousness anything that has been there before.[1] All our ideas are associated with other ideas, and by means of these they are recalled. Did an idea exist in the mind unassociated with any other idea it could not be recalled. According to the strength of the association, and the character of the ideas with which the association is formed, will be the power of recall.

If then we improve and strengthen the faculty of attention, and judiciously attend to the association of our ideas, we shall bring the reproductive power of the mind nearer to an equality with the retentive, and so vastly improve the natural memory. Indeed there seems no reason in the nature of things why we should forget anything that has once been in the mind, or that we should not be able to recall it when we wish to do so. That there is nothing impossible in this view is shown by the fact that there have been men who have had such memories. Thus it is reported of Pascal "that till the decay of his health had impaired his memory, he forgot nothing of what he had done, read, or thought in any part of his natural age".

[1] "Next to the effect of attention is the remarkable influence produced upon memory by association. . . . The principle of association is founded upon a remarkable tendency, by which two or more facts or conceptions which have been contemplated together, or in immediate succession, become so connected in the mind that one of them at a future time recalls the others."—*Dr. Abercrombie.*

—*John Locke.* The same is recorded of Grotius and others.[1]

Though it is convenient to speak of the memory, as is usually done, as if it were a single faculty, this is not strictly or properly the case, for it is really a property or quality of all the faculties, each having its own individual memory, though there are certain principles common to all of them.[2] As each has its separate action, so each has its distinct memory, which is simply a record of what each has done or experienced. Thus the eye records what it sees, the ear what it hears, and the other senses what come within their several spheres, as well as the intellect what it thinks, the emotions what they feel, the will what it commands, and the muscles what they do. Not only so, but each different class of sensations of any of the senses, each form of activity of any of the faculties, every different kind of voluntary movement of any part of the body has its distinct memory. Wherever we have distinction of

[1] "Grotius and Pascal forgot nothing they had ever read or thought."—*Sir W. Hamilton.* Cardinal Mezzofanti, who is said to have known more than a hundred different languages, used to declare that he never forgot a word that he had once learnt, and to this, doubtless, was owing his power as a linguist. It is related of Dr. John Leyden "that after he had gone to Calcutta, a case occurred where a great deal turned on the exact wording of an Act of Parliament, of which, however, a copy was not to be found in the Presidency. Leyden, who, before leaving home, had had occasion to read over the act, undertook to supply it from memory; and so accurate was his transcript that when, nearly a year after, a printed copy was obtained from England, it was found to be identical with what Leyden had dictated."

[2] Memory "is not a special faculty beside and apart from the original powers of the soul," but "consists simply and solely in the peculiarity which they possess of retaining to a greater or less degree the stimulants received by them".—*Dr. Beneke.* "Memory may be resolved into memories just as the life of an organism may be resolved into the lives of the organs, the tissues, the anatomical elements which compose it."—*Th. Ribot.*

action, there we have distinction of memory,—which is the action's record, the traces left of its activity; and where the action is most developed, there the memory is strongest.[1]

A leading error that arises from regarding the memory as a single faculty is the belief that, in whatever direction we exercise it, we improve it as a whole. This, however, is very far from being the case. If we exercise it only in one direction, we improve it only in that direction. The exercise of the ear in hearing does not improve the power of vision, nor while we strengthen the memory for sounds do we improve that for sights. Even in a single sense or faculty we find different forms and degrees of memory,—as in sight for persons, places, forms, colours, and the like. Hence we may cultivate the memory for persons without at all improving that for places, and a good memory for colours may afford little help towards the remembrance of forms.[2] In like manner, a musician may be able to remember and reproduce a beautiful air that he has heard only once, while he may be unable to remember and repeat half a dozen or a dozen words after once hearing them.

Another error that may be traced to the same cause is that of regarding the memory only or chiefly as it is manifested in its lower forms, and hence depreciating

[1] "The same act that favours discrimination favours retention. . . . No law of the intellect appears to be more certain than the law that connects our discriminating power with our retentive power. In whatever class of subjects our discrimination is great—colours, forms, tones, tastes—in that class our retention is great."—*Prof. Bain.*

[2] "Does not daily observation show us that some persons remember forms most easily, while others have a special facility for recalling colours."—*Th. Ribot.* "Some remember the shapes of objects, and yet have the greatest difficulty in remembering their colour, and so on."—*R. Verdon.*

or undervaluing its importance. Thus many speak of a good memory as if it were a matter of mere secondary consideration, and not a few hold that when highly cultivated it interferes with the efficiency of certain of the other faculties, particularly the imagination or the reasoning powers. "Seldom," says one, "are a powerful imagination, a sound understanding, and a clear discernment united with a vigorous and retentive memory." "A great or comprehensive memory is seldom connected with a good judgment."—*Lord Kames.* "Mere memory," says Dr. Mortimer Granville, "is not either a very exalted or an intellectual faculty. The lower animals and many idiots excel intelligent men in this quality—the receptive and retentive plasticity of brain." Sir William Hamilton mentions the case of a Corsican who was said to be able to repeat 36,000 names after once hearing them; "but," says Gregorovius, from whom he takes his information, "he produced nothing, his memory had killed all his creative power. . . . It is with the precious gift of memory as with all other gifts, they are the curse of the gods when they give too much." [1]

The memory for names and words is the lowest form of memory, and fools and even idiots are sometimes found to manifest it in a very remarkable degree.[2]

[1] "A good memory, which is in itself so essential an accompaniment of profound and accurate judgment, has fallen into a sort of proverbial disrepute, as if unfriendly to judgment, or indicative of a defect in this nobler part of our intellectual constitution. . . . It is not a good memory, in its best sense, as a rich and retentive store of conceptions, that is unfriendly to intellectual excellence, —poetic or philosophic,—but a memory of which the predominant tendency is to suggest objects or images which existed before, in the very order in which, as objects or images, they existed before, according to the merely imitative relations of contiguity."—*Dr. T. Brown.*

[2] "A person may have a very strong, capacious, and retentive

Hence to judge of the value and importance of memory simply from the lower aspects of it is manifestly unfair. The memory for words is only one form of memory, besides which there are memories for ideas, for processes of reasoning, for creations of the imagination; and to say that memory interferes with the efficiency of any of the other faculties is to regard as one thing what is in reality many things, and to confound the lower forms of it with the higher.[1] The memory of any individual faculty cannot be too strong for the efficiency of that faculty; as, for instance, the memory for words for what may be called the word faculty, the memory for processes of reasoning for the reasoning faculty, or the memory for creations of the imagination for the imaginative faculty. The power of creating depends upon the power of remembering, and he who has most enriched his mind with the stores of nature and of art will always

memory where the judgment is very poor and weak, as sometimes happens to those who are but one degree above an idiot, who have manifested an amazing strength and extent of memory."—*I. Watts.* Canon Fearon mentions a man in his father's parish "who could remember the day when every person had been buried in the parish for thirty-five years, and could repeat, with unvarying accuracy, the name and age of the deceased and the mourners at the funeral". But, "out of the line of burials, he had not one idea, could not give an intelligent reply to a single question, nor be trusted even to feed himself". "I have heard a boy whose faculties were, in other respects, rather below the ordinary pitch repeat the greatest part of a sermon after once hearing it."—*Dr. J. Beattie.* R. Verdon refers to "the idiot mentioned by Mrs. Somerville, who could repeat a sermon verbatim, indicating also where the minister blew his nose or coughed during the performance".

[1] "The man of genius sometimes appears to want memory only from the too confined signification given to the word memory, in restraining it to the remembrance of names, dates, persons, and places, for which the man of genius has no curiosity, and often finds that here his memory fails him. But comprehending in the signification of this word the remembrance of ideas, images, and reasonings, none of them is deficient. . . . There is no such thing as genius without memory."—*Helvetius.*

have the most fertile and readiest invention. "The richer the memory, and consequently the greater the number of images that may arise to the poet, and of powers and effects that may arise to the philosopher, the more copious in both cases will be the suggestions of analogy which constitute poetic invention or philosophic discovery, and the more copious the suggestions of analogy may be, the richer and more diversified, it is evident, must be the inventive power of the mind."—*Dr. Thomas Brown.*[1]

We may distinguish three different degrees or forms of memory. The first or lowest is what may be called "local" or "verbal" memory, "that is," says Dr. Abercrombie, "the power of remembering facts in the order in which they occurred, or words in the order in which they were addressed to the individual". This "kind of memory," he continues, "is often the more ready, and is that which generally makes the greater

[1] "Memory, far from being incompatible with genius, seems even to be necessary to its utmost perfection for those happy exertions of intellect which confer immortality upon their authors. . . . If we look around us at those individuals who have acquired eminence as men of genius, or examine into the endowments of those who have formerly been famed for their intellectual exertions, we shall uniformly find that a retentive and capacious memory proved the basis upon which their literary fame was reared."—*Prof. Scott.* "A strong memory and a fertile invention frequently go together, the former being of the utmost utility to the latter. If a man shall sit down to invent he will find that a complete retrospect of all he has seen, heard, or read relative to any science will afford him the greatest assistance in his farther inventions or improvements in that science."—*Dr. W. Hooper.* "We are indebted to the mechanical genius of Watt for the invention of the steam engine; but the genius of Watt consisted in the remembrance of a variety of objects, facts, principles, requirements, and appliances suggested to his mind by the sight of a steaming tea-kettle."—*W. Stokes.* "It is in vain for painters or poets to endeavour to invent without materials on which the mind may work and from which inventions must originate. . . It is by being conversant with the inventions of others that we learn to invent."—*Dr. W. B. Carpenter.*

show, both on account of its readiness and likewise because the kind of effects with which it is chiefly conversant are usually those most in request in common conversation".[1] "It is in common conversation chiefly that we judge of the excellency of the memory of others, and that we feel our own defect of it; and the species of relation which forms by far the most important tie of things in ordinary discourse is that of previous contiguity. We talk of things which happened at certain times and in certain places, and he who remembers these best seems to us to have the best memory. . . . The most ignorant of the vulgar, in describing a certain event, pour out a number of suggestions of contiguity which may astonish us indeed, though they are a proof not that they remember more, but only that their prevailing suggestions take place according to one almost exclusive relation. It is impossible to listen to a narrative of the most simple events by one of the common people, who are unaccustomed to pay much attention to events but as they occur together, without being struck with a readiness of suggestion of innumerable petty circumstances which might seem like superiority of memory, if we did not take into account the comparatively small number of their suggestions of a different class."—*Dr. T. Brown.* A remarkable instance of this kind of memory is given by Shakespeare in the character of Dame Quickly, as she narrates with astonishing minuteness the various incidents that occurred at the time when Sir John Falstaff made her a promise of marriage.

[1] "The species of memory which excites the greatest degree of admiration, in the ordinary intercourse of society, is a memory for detached and isolated facts; and it is certain that those men who are possessed of it are very seldom distinguished by the higher gifts of the mind."—*D. Stewart.*

It is usually in persons whose minds are not highly cultivated, and whose mental faculties have not been much exercised, that we find this kind of memory displayed in the most marked degree. Not having been much called forth in its higher stages, it has consequently developed itself more in this, its lower. Persons of this class will sometimes be found able to perform great feats of memory, repeating, it may be, long lists of names, or many lines of poetry after once hearing them, or a speech, or a sermon almost verbatim, or narrating the minutest particulars of an event that occurred perhaps long ago.[1] In general, however, they can only repeat the words or record the incidents as they actually occurred. They cannot, as a rule, leave out some and enlarge upon others, nor can they readily recur to an incident that happened at a different time. If they wish to recall a particular passage in a speech or a book, they may be unable to do so without commencing at the beginning and repeating down to it; and frequently it would seem that

[1] "People of very inferior mental gifts often have a marvellous memory for little insignificant details, and can repeat to you with great accuracy the very words of a conversation or the precise incidents of a story which they have once heard."—*J. G. Fitch.* "We may find a mere local memory combined with very little judgment." —*Dr. Abercrombie.* "Extraordinary powers of remembrance are sometimes coupled with a childish understanding."—*Dr. Beattie.* "We in the West have little idea of the precision with which an eastern pupil even now can take up and remember the minutest details of a lesson, reproducing them years afterwards in the exact words of his master."—*Dr. W. Robertson Smith.* Dr. Moffat, the distinguished missionary, after preaching a long sermon to a number of African savages, saw at a distance a simple-looking young man holding forth to a number of people, who were all attention. On approaching, he found to his surprise that he was preaching his sermon over again, with uncommon precision and with great solemnity, imitating as nearly as he could the manner and gestures of the original.

the words which they learn so readily convey no ideas to their minds, being doubtless on that account more easily learnt.[1]

A higher form of memory is where not merely an individual past state of the mind—a sensation, thought, or feeling—with its attending circumstances, is recalled, but where a number of past states, having a greater or less resemblance to each other, are reproduced at the same time. When the mind comes to possess a number of ideas of the same or a similar kind, and the reasoning power is in some degree developed, a principle of association and comparison comes into play, so that the mind brings together and compares those that most nearly resemble each other, and thus arranges and classifies them. Hence, on the presentation of a new object, it immediately seeks for something similar among its past ideas or sensations, brings the two together so as to compare them, and notes their

[1] Speaking of Dr. Leyden, who was remarkable for his great memory, Dr. Abercrombie says: "I am informed through a gentleman, who was intimately acquainted with him, that he could repeat correctly a long act of parliament, or any similar document, after having once read it. When he was on one occasion congratulated by a friend on his remarkable power in this respect, he replied that, instead of an advantage, it was often a source of great inconvenience. This he explained by saying that when he wished to recollect a particular point in anything which he had read, he could do it only by repeating to himself the whole from the commencement till he reached the point which he wished to recall." It is recorded of the Welsh boy, Richard Roberts Jones, who was remarkable for his linguistic powers, that his other faculties were of an extremely low order, and that even the books which he read in the foreign tongues seemed to convey no ideas to his mind. "In extreme cases of this endowment, the memory of an exposition or discourse is consistent with a total ignorance of the meaning."—*Prof. Bain.* "I have known more than one instance of an individual who, after having forgotten completely the classical studies of his childhood, was yet able to repeat with fluency long passages from Homer and Virgil without annexing an idea to the words that he uttered."—*D. Stewart.*

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agreements and differences. Thus a circumstance of yesterday, in place of recalling other circumstances of yesterday that immediately preceded or followed it, would recall various circumstances of a similar nature that happened probably at very different times. It is of the utmost importance to us, in forming our judgment of things or in determining upon a particular line of conduct, to be able to bring together before the mind a number of instances of the same or a like kind, recent or long past, which may aid us in coming to a right determination. In the former kind of memory the associative principle at work is contiguity; in this it is similarity.

When this higher form of memory, which we may call the "rational," comes to more and more characterise the mind, the lower form becomes less strong or marked, and hence men of talent and culture are frequently said to have bad memories, the fact being that they have simply passed from a lower form of it to a higher. The commonplace incidents of the day take little hold on them, because their minds are actuated by a higher principle,—association by similarity taking the place of that by mere contiguity. "The trivial occurrences of the day," says Dugald Stewart, "in general escape the recollection of a man of ability, not because he is unable to retain them, but because he does not attend to them." The strength of this kind of memory, when we think of how much it contains, to say nothing of the greater value and utility of its contents, vastly surpasses the other.[1]

[1] "The great difference is that the wealth of the one is composed merely of those smaller pieces which are in continual request, and, therefore, brought more frequently to view, while the abundance of the other consists chiefly in those more precious coins which are rather deposited than carried about for current use, but which, when

The highest form of memory is that in which past ideas or sensations are, as it were, imaged forth as if they were objects of actual perception.[1] This is what Sir W. Hamilton calls "the representative faculty," or "the power which the mind has of holding up vividly before itself the thoughts which, by the act of reproduction, it has called into consciousness".[2] The term imagination is commonly employed to designate this power,[3] and it is usually regarded as a distinct faculty of the mind, but we rather agree with those philosophers who consider it merely as a form or part of memory, there being no essential difference between them.[4]

brought forward, exhibit a magnificence of wealth to which the petty counters of the multitude are comparatively insignificant."—*Dr. T. Brown.* "The man of genius commonly has his information much less at command than those who are possessed of an inferior degree of originality; and what is somewhat remarkable, he has it least of all at command on those subjects on which he has found his invention most fertile."—*D. Stewart.*

[1] "It is not always the person who recollects most easily and correctly who can exhibit what he remembers in the most vivid colours."—*Sir W. Hamilton.*

[2] "The act of representation is merely the energy of the mind in holding up to its own contemplation what it is determined to represent."—*Sir W. Hamilton.*

[3] "Imagination would be the term which, with the least violence to its meaning, could be accommodated to express the representative faculty."—*Sir W. Hamilton.*

[4] "Memory Aristotle does not view as a faculty distinct from imagination, but simply as the recalling those impressions, those movements into consciousness, of which phantasy is the complement."—*Sir W. Hamilton.* "Memory pertains to that part of the soul to which also imagination pertains, and those things are essentially objects of memory which are objects of imagination."—*Aristotle.* "Imagination is just a form of memory. . . . In all our imaginings we are simply remembering—remembering not methodically but loosely—not according to old collocations and contiguities alone, but also according to the laws of resemblance and contrast. But still it is memory: memory furnishes the whole weft and woof for every web, however brilliant the colouring which imagination weaves."—*Dr. J. Cunningham.*

Philosophers usually distinguish two kinds of imagination—the reminiscent or reproductive, and the constructive, creative, or productive.[1] By the former the objects are simply represented as they previously appeared, without any alteration or change. The latter, which is usually designated by imagination or fancy, is that in which past events are presented not as they previously happened, but in combination with other events belonging, it may be, to different periods.[2] In the former we reproduce past sensations or ideas as they previously existed; in the latter we may take only certain of them and arrange them in a particular way, or we may take parts of one and parts of another and bring them together so as to form an image more beautiful perhaps than anything to be found in nature, yet the different parts of which it is composed have all been taken from nature, and been matter of actual experience.[3] In memory too,

[1] "Philosophers have divided imagination into two—what they call the reproductive and the productive. By the former they mean imagination considered as simply re-exhibiting, representing the objects presented by perception—that is, exhibiting them without addition or retrenchment, or any change in the relations which they reciprocally held when first made known to us through sense."—*Sir W. Hamilton.*

[2] "The reproductive imagination is not a simple faculty. It comprises two processes: first, an act of representation strictly so called; and secondly, an act of reproduction arbitrarily limited by certain contingent circumstances. . . . The productive or creative imagination is that which is usually signified by the term imagination or fancy in ordinary language."—*Sir W. Hamilton.*

[3] "What is imagination but memory presenting the objects of prior conceptions in groups or combinations which do not exist in nature."—*Dr. Payne.* "Fancy may combine things that never were combined in reality. It may enlarge or diminish, multiply or divide compound and fashion the objects which nature presents; but it cannot by the utmost efforts of that creative power, which we ascribe to it, bring any one single ingredient into its production which nature has not framed and brought to our knowledge by some other

as in imagination, analysis and association are operations that are constantly going on, for it is necessary to analyse or reduce into parts, in order to fix clearly in the mind what we wish to remember, and we associate or bring together in the mind those ideas or sensations that we wish to recall each other.[1]

Wherever we have this power of imagination, this representative faculty most highly developed, there we have the memory in its most perfect form. We have it, for instance, in him who can recall a past event so vividly that it seems as if it were again present to him; in him who, after reading a passage in a book, can recall the form and appearance of every word as if it were still before him; or in him who, after hearing a speech, can bring back again the very sounds of the words as it were in his ears.[2] It is

faculty."—*Dr. T. Reid.* "The most brilliant imagination never yet produced anything which had not been seen, heard, or felt, as it were, piecemeal; the combination is new, but the material thus woven afresh is what all are acquainted with."—*J. Barlow.* "It is admitted on all hands that imagination creates nothing, that it produces nothing new."—*Sir W. Hamilton.* "All the creative power of the mind amounts to no more than the faculty of compounding, transposing, augmenting, or diminishing the materials afforded us by the senses and experience."—*D. Hume.*

[1] "The congeries of phenomena called up by the reproductive faculty . . . are separated into parts, are analysed into elements; and these parts and elements are again compounded in every various fashion. In all this the representative faculty co-operates."—*Sir W Hamilton.*

[2] "Some few persons see mentally in print every word that is uttered . . . and they read them off usually as from a long imaginary strip of paper, such as is unwound from telegraphic instruments." —*Francis Galton.* A child, grand-daughter of Mr. Bidder, the distinguished mental calculator, remarked: "Isn't it strange? When I hear anything remarkable read or said to me, I think I see it in print." A brother of the calculator, a Unitarian minister, had an extraordinary memory for Biblical texts, and could give chapter and verse of almost any passage in the Bible, or, on getting chapter and verse, could repeat the passage. A writer in *The Spectator*, who

this power that enables the artist to carry in his mind the various minutiæ of a scene, so that he can afterwards paint it from memory;[1] the poet to be so filled with the beauty and fragrance of nature that he can afterwards describe it as if it were actually present;[2] the inventor to hold in his mind the various parts of his design, so that he can mark and calculate their several effects;[3] the chess-player to note the series of results that will follow a particular move, or, most wonderful of all, to play a number of different games (sometimes as many as sixteen or twenty) at the same

mentions this, says that it probably "arose from a power of seeing in some visionary Bible the exact place and appearance of the text in question. Probably what he recalled was the aspect of the printed text, from which he mentally read off the words and the reference."

[1] "Certain painters, draughtsmen, and sculptors, after attentively considering a figure, are able to draw it from memory. Gustave Doré has this faculty; Horace Vernet had it. In a school of arts at Paris the pupils were practised in copying models from memory. After four months' practice they said that the image had become much more distinct, and if it disappears they can recall it almost at will."—*H. Taine.* "Doré's memory of anything he had once seen was," we are told, "marvellous; and he seemed to work at night as if the scenes he had made note of during the day were still before his eyes." After once driving through Windsor Park "he knew every tree by heart that he had glanced at, and said that he could draw all from memory".—*B. Roosevelt.*

[2] "The great writers whose vivid descriptions of scenery or events hold our attention and stir our feelings have this power in a high degree; they create for themselves a world of sense by the influence of ideas, and then strive to present vividly to us what they have thus represented to their own minds. . . . Goethe could call up an image at will and make it undergo various transformations as it were before his eyes."—*Dr. H. Maudsley.*

[3] "A strong imagination, that is, the power of holding up any ideal object to the mind in clear and steady colours, is a faculty necessary to the poet and to the artist, but not to them alone. It is almost equally requisite for the successful cultivation of almost every scientific pursuit. . . . The vigour and perfection of this faculty are seen not so much in the representation of individual objects and fragmentary sciences as in the representation of systems."—*Sir W. Hamilton.*

time, without seeing any of the boards.[1] Those who have been distinguished for their power to carry out long and intricate processes of mental calculation owe it to the same cause.[2]

[1] "Paul Morphy, the American, was the first who made an especial study of this kind of display, playing some seven or eight games blindfold and simultaneously against various inferior opponents. . . . Since his day many chess-players, who are gifted with strong and clear memory and power of picturing to the mind the ideal board and men, have carried this branch of exhibition play far beyond Morphy's pitch. . . . Blackburne and Zukertort can play as many as sixteen or even twenty blindfold games at a time, and win about 80 per cent. of them at least."—*Pall Mall Gazette.* "With chess-players who play a game with their eyes closed or their faces turned towards the wall . . . evidently the figure of the whole chess-board, with the different pieces in order, presents itself to them at each move, as in an internal mirror, for without this they would be unable to foresee the probable consequences of their adversaries' and their own moves."—*H. Taine.* "One of the great chess-players, who can play not merely two but twelve games at once without seeing the boards, expressly stated that he had before him a perfectly vivid picture of each board, which altered instantaneously as each move was made, and thus remained printed on his mind till another move again changed the situation."—*The Spectator.*

[2] "Children accustomed to calculate in their heads write mentally with chalk on an imaginary board the figures in question, then all their partial operations, then the final sum, so that they see internally the different lines of white figures with which they are concerned. . . . Young Colburn, who had never been at school, and did not know how to read or write, said that, when making his calculations, 'he saw them clearly before him'. Another said that he 'saw the numbers he was working with as if they had been written on a slate'."—*H. Taine.* "If I perform a sum mentally," said Mr. Bidder, "it always proceeds in a visible form in my mind; indeed, I can conceive no other way possible of doing mental arithmetic." "He had the faculty," says a writer in *The Spectator*, "of carrying about with him a vivid mental picture of the numbers, figures, and diagrams with which he was occupied, so that he saw, as it were, on a slate the elements of the problem he was working." He had "the capacity for seeing, as if photographed on his retina, the exact figures, whether arithmetical or geometrical, with which he was occupied at the time". It is related of Dr. Porson, who was remarkable for his great memory, that on one occasion he called on a friend, whom he found reading Thucydides. His friend asked him the meaning of some word, when Porson immediately repeated

Nor is it to be supposed that this power of imagination or vivid representation is confined to objects of sense. "On the contrary," says Sir W. Hamilton, "a vigorous power of representation is as indispensable a condition of success in the abstract sciences as in the poetical and plastic arts." [1] Intellectual ideas and processes of reasoning are represented to the mind in the same way. The orator, for instance, so vividly represents to his mind the different parts of his discourse that he has no difficulty in running over them in any direction and arranging them in the best way to bring out the end he has in view. To him they are almost as much material objects as if he had seen and handled them in material form.[2]

Thus while vulgar minds are held in thraldom to the order and circumstances in which their perceptions were originally obtained, and can only reproduce them

the context. "But how do you know that it was this passage I was reading?" asked his friend. "Because," replied Porson, "the word occurs only twice in Thucydides; once on the right-hand page in the edition which you are using, and once on the left. I observed on which side you looked, and accordingly I knew to which passage you referred." Lord Macaulay was remarkable for his great memory, and it is said of him that "every incident he heard of, every page he read, assumed in his mind a concrete spectral form".

[1] "Imagination, or phantasy, in its most extensive meaning, is the faculty representative of the phenomena both of the external and internal worlds."—*Sir W. Hamilton.*

[2] It is said of Robert Hall "that he never proceeded even to think of a specific text as fitted for a sermon until the matter it presented stood out in the form of a particular distinct and specific topic; he could then take it up and lay it down as he pleased". We are told of Mrs. Henry Wood, the novelist, that "she first composed her plot. . . . Once thought out . . . the drama had then become to her as real as if it had actually existed . . . and stood visibly before her as if she were actually looking upon a diorama. . . . It also enabled her to take the greatest interest in her story and in her characters. She believed in them, realised them, looked upon them as living people. To her they had as much an existence as her own friends."

in the same manner, the cultivated mind, having this faculty strong, sees the end from the beginning, and arranges his materials in the way best calculated to bring out the end he has in view, passing over, it may be, a number of details that are not essential to his purpose.[1]

The writer in *The Spectator* already quoted very well points out the superiority of this kind of memory over that by association, whether of contiguity or similarity, confining, however, to words and numbers what is of much wider application. "It is certain," he says, "that those who have it (*i.e.*, the power of imaging) have an enormous advantage over those who remember by association only—who do not see any picture . . . of the number or words with which they are dealing, but have to call them up by the force of association of each with the next in succession. The difference, indeed, between learning 'by heart,' or, as it is called, 'by rote,' and summoning up before the imagination a page on which all the words or numbers required stand forth in black and white, as the trees of your garden, or the houses within sight of your home stand out in your memory the moment you choose to summon them up, is enormous. And probably the difference is great in regard to the confidence reposed

[1] "A vulgar mind forgets nothing and spares nothing; he is ignorant that conversation is always but a selection; that every story is subject to the laws of dramatic poetry, *festinat ad eventum;* and that all which does not concur to the effect destroys or weakens it. . . . Minds of this description are held in thraldom to the order and circumstances in which their perceptions were originally obtained."—*Sir W. Hamilton.* "It has been often remarked that the perfection of description does not consist in a minute specification of circumstances, but in a judicious selection of them. . . . In the man who composes the coherent discourse, the main idea, that of the end in view, predominates and controls the association in every part of the process."—*D. Stewart.*

in each kind of memory. . . . Everyone knows how much more unhesitatingly we read off from a vivid mental picture than merely repeat from association. In the former case, whether truly or falsely, we seem to ourselves to be speaking from actual sight; in the latter only from habit. . . . The mere vividness of it gives us a confidence which we seldom have when relying on the law of association alone."

It is not meant that each individual memory will exist only in one or other of these forms, or belong to one or other of these classes; for sometimes persons are found who possess them all in great efficiency, and that is the most perfect memory in which they all exist in due proportion. Usually, however, one form is found to greatly predominate over the others, so as to give a distinct character to the memory.

In order to remember a thing, we must first of all have had it previously in the mind.[1] We cannot be said to remember what has not already been matter of thought or observation to us. We perceive the present, we anticipate the future, but we remember the past.[2] A sensation or an idea then, in order to be the subject of memory, must at some previous time have been present to the mind, and there is always along with the thing remembered the consciousness of its having been in the mind before.[3]

[1] "When the image of anything is impressed on the memory, the thing itself must needs be first present, whence the image may first be impressed."—*St. Augustine.* "There can be no memory of what we have not had experience of in whole or in part."—*Dr. Maudsley.*

[2] "The object of memory or thing remembered must be something that is past, as the object of perception or consciousness must be something that is present."—*Dr. T. Reid.*

[3] "Reproduction is not all that constitutes memory; for there must be in addition a recognition of the reproduced state of consciousness as one which has been formerly experienced."—*Dr. Carpenter.*

A sensation or an idea present to the mind for the first time, and its subsequent recall in the memory, have many features in common;[1] and indeed the more closely and accurately the recalled sensation corresponds to the original the better is it said to be remembered. Usually the recalled impression is less distinct or marked than the original, but otherwise there is little to distinguish them,[2] so that in abnormal states of the mind the one is frequently mistaken for the other; and the phantasms of our dreams or the hallucinations of a fever have all the appearance of reality.[3] Indeed, it may well be doubted if we should be able to distinguish an idea from a sensation—a subjective from an objective feeling—did not reason or some of the other senses come to our aid.[4]

[1] "It is plain that memory is closely allied to sensation, and that the resemblance between the two orders of phenomena is so great as to justify the suspicion that the nervous system is instrumental in producing the one as well as the other."—*Sir B. Brodie.* "Between conceiving a sensation and really perceiving it there is only a difference of degree. . . . The mere idea of a nauseous taste can excite the sensation, even to the production of vomiting."—*Prof. Bain.*

[2] "Between the sensible perception of an object and the reproduced image of the object there is chiefly a quantitative difference in the physiological and psychological processes: the image is a faint sensation."—*G. H. Lewes.*

[3] "Everyone is familiar with the fact that sensations formerly experienced are reproduced in dreaming with a vividness and reality quite equal to that with which his consciousness was originally impressed by the actual objects; and this not unfrequently happens also in the waking state."—*Dr. Carpenter.* "Dreams have frequently a degree of vivacity which enables them to compete with the reality; and if the events which they represent to us were in accordance with the circumstances of time and place in which we stand, it would be almost impossible to distinguish a vivid dream from a sensible perception—*Ancillon.* "It is only because dreams are different and inconsistent that we can say when we awake that we have dreamt."—*Pascal.*

[4] "There seems to be no difference in the feelings of the individual between the sensations thus originating (*i.e.*, subjectively) and those

This similarity in the two states naturally leads us to look for a like similarity in their causes or circumstances. In other words, we are led to believe that when a sensation that has once been in the mind is recalled, the same parts are affected and the same physical conditions reproduced as when it was originally present.[1] Professor Bain says: " It must be considered

which are produced in the usual manner; for we find that unless convinced to the contrary by their reason, persons who witness spectral illusions believe as firmly in the reality of the objects that come before their minds as if the images of those objects were actually formed on their retinæ."—*Dr. Carpenter.* " If the idea of the sweetness of sugar should be excited in our dreams, the whiteness and hardness of it occur at the same time by association, and we believe a material lump of sugar present before us. But if in our waking hours the idea of the sweetness of sugar occurs to us, the stimuli of surrounding objects . . . prevent the other ideas of the hardness and whiteness of the sugar from being exerted by association."—*Dr. E. Darwin.* " Imaginary acts are always accompanied by the belief (at least for the moment) in the existence of the corresponding reality. This illusion, which exists in the highest degree in hallucination vertigo, and dreams (for want of real perceptions to correct it), also exists, although in a less degree, in all states of consciousness. So long as an image, whatever its content (whether it represents a house or a mechanical invention or a sentiment), remains isolated, as i suspended in consciousness, with no relation to other states, having a fixed position incapable of classification, so long we regard it as a present existence."—*Th. Ribot.* " I am inclined to think, after the most careful attention to what I experience in myself, that the exercise both of conception and imagination is always accompanied with a belief that their objects exist. . . . Whenever the objects of imagination engross the attention wholly . . . they produce a temporary belief of their reality. . . . It is a strong confirmation of this doctrine that in sleep, when the influence of the will over the train of our thoughts is suspended . . we ascribe to the objects of imagination an independent and permanent existence, as we do when awake to the objects of perception."—*D. Stewart.*

[1] " It is very probable that recollections occupy the same anatomical seat as primitive impressions, and that they excite the activity of the same nervous elements."—*Th. Ribot.* " When I recollect the appearance of an oak, my internal organs must necessarily at the time be in the same situation in which they were when I saw that oak."—*Helvetius.* " Our recollection or imagination of externa

as almost beyond a doubt that the renewed feeling occupies the very same parts and in the very same manner as the original feeling and no other parts, nor in any other manner that can be assigned". "To recall a motion just made with the arm is," says Herbert Spencer, "to have a feeble repetition of those internal states which accompanied the motion—is to have an incipient excitement of those nerves which were strongly excited during the motion".[1]

As we shall afterwards see, a sensation is caused by an object impinging upon an organ of sense and setting up there a form of motion, which is conveyed, by means of connecting nerve-fibres, to the brain, where it becomes an object of consciousness.[2] In like manner, when voluntary motion is purposed, motion originates in the brain and passes along the nerves to the muscles, which are thus brought into action.

It seems highly probable, then, that the recalled sensation or idea is occasioned by a repetition of the same form of motion as attended the original sensation.[3] The sensation of red is produced by a

objects consists of a partial repetition of the perceptions which were excited by these external objects at the time we became acquainted with them."—*Dr. E. Darwin.*

[1] "A movement, whether real or ideal, is mentally known as a definite expenditure of energy in some special muscle or muscles."—*Prof. Bain.* "Ideas are nothing else than weak repetitions of the psychical states, caused by actual impressions and motions."—*H. Spencer.*

[2] "External objects impressed upon the senses occasion first in the nerves on which they are impressed, and then in the brain, vibrations of the small and, as one may say, infinitesimal medullary particles." —*Dr. Hartley.* "The only way in which the external world affects the nervous system is by means of motion. Light is motion, sound motion, heat motion, touch motion, taste and smell, all motion."—*J. D. Morell.* "We have the strongest reason for believing that what the nerves convey to the brain is in all cases motion."—*Prof. Tyndall.*

[3] "Our ideas of imagination are repetitions of the motions of the

certain kind of motion, and the idea of red is in all probability induced by the same kind of motion.[1] This doctrine is as old as the days of Aristotle, who viewed the representations of memory or imagination "as merely the movements continued in the organ of internal sense after the moving object itself has been withdrawn".—*Sir W. Hamilton.*[2]

It is the general opinion of physiologists that the movements on which our recalled sensations depend are confined to the brain, which is therefore regarded as the sole seat of the memory.[3] This is probably the case

nerves, which were originally occasioned by the stimulus of external bodies."—*Dr. E. Darwin.* "It cannot but be that those vibrations which accompany sensations should beget something which may accompany ideas in like manner; and this can be nothing but feebler vibrations agreeing with the sensory-generating vibrations in kind, place, and line of direction."—*Dr. Hartley.*

[1] "The simple ideas that we call up by recollection . . . as the colour red, or the smell of a rose, are exact resemblances of the same simple ideas from perception, and in consequence must be a repetition of those very motions."—*Dr. E. Darwin.*

[2] According to the ancient peripatetics, "we may conceive to be formed within us, as from the operation of our senses about sensible objects, some impression, as it were, or picture in our original sensorium, being a relic of that motion caused within us by the external object; a relic which, when the external object is no longer present, remains and is still preserved, being, as it were, its image, and which, by being thus preserved, becomes the cause of our having memory." —*Dr. T. Reid.* "By idea in the sense of corporeal species, Descartes did not mean a picture, likeness, or image of the object existing in the brain, but simply a certain organic movement or agitation of the nerves determined by the object, and communicated to the brain, the seat of the *sensus communis.*"—*Prof. Veitch.*

[3] "In the recollection of sensuous things the mind refers to a brain in which are retained the effects, or rather the likenesses, of changes that past impressions and intellectual states had made."—*Sir J. Paget.* "Memory means physiologically the same part of the brain in activity as on the former occasion . . . with this difference, that it has been in action before, and has an ingrained record thereof."—*Dr. Maudsley.* "It is not to be doubted that those motions which give rise to sensation leave on the brain changes of its substance which answer to what Haller called *vestigia rerum,* and to what that great

in many instances, as where the previous sensation is only imperfectly recalled; but where it is brought back with any degree of vividness, as in the highest form of memory, we are of opinion that the motion is not confined to the brain, but extends also to the connecting nerves, and even to the special organ of sense, as in the original sensation,[1] with this difference, that in sensation the motion originates in the external organ and travels inward to the centre, whereas in recollection it originates in the centre and passes outward to the outer organ.[2] It is well known that if we gaze for a time on a particular bright colour the retina becomes exhausted for the reception of that colour, and the object assumes the appearance of the complementary one. Now, if, in place of gazing, we shut our eyes and vividly imagine

thinker David Hartley termed 'vibratiuncules'. The sensation which has passed away leaves behind molecules of the brain competent to its reproduction—'sensigenous molecules,' so to speak, which constitute the physical foundation of memory."—*Prof. Huxley.*

[1] "As sensation has its seat in one portion of the organism . . . which is not the brain only, but also the afferent nerves, the idea or the ideal sensation must have the same seat."—*Prof. Bain.* "The organ which the imagination employs in the representation of sensible objects seems to be no other than the organs themselves of sense, on which the original impressions were made and through which they were originally perceived."—*Sir W. Hamilton.* "The same volition that rules the bodily eye can rule the mental, because the mental is still the bodily one."—*Prof. Bain.*

[2] "I am disposed to conclude that as in perception the living organs of sense are from without determined to energy, so in imagination they are determined to a similar energy by an influence from within."—*Sir W. Hamilton.* "In seeking to recall the image of a friend, there is a consciousness of the struggle taking place, first in the head, and slowly and finally in the organ of sense. It is an interesting fact that with persons in whom images easily acquire the energy of sensations, the feeling of effort is always localised in the sense organ rather than in the head; whereas with those persons in whom images have less energy and were less easily recalled, the effort is more felt in the head. Very familiar images—*i.e.*, those constantly excited—are felt in the sense organ from the first."—*G. H. Lewes.*

the colour, the same effect is produced—the retina becomes exhausted, and the complementary colour takes the place of the original one, showing clearly that the retina is concerned in the latter case as in the former.[1] And what holds true with regard to sight is doubtless true also in regard to the other senses, and even to our muscular activities, so that in going over in thought a certain course of action we exercise the same parts (at least as far as the nerves are concerned), and produce a measure of fatigue of the same kind as attends the performance of the actual movements.[2] It is worthy of remark, too, that the time taken up in mentally going over a course of action is usually much the same as that taken up in actually performing the movements.[3]

[1] "Thus if the eye be fixed for any length of time upon a bright red spot on a white ground, and then be suddenly turned so as to rest upon the white surface, we see a spectrum of a green colour."—*Dr. Carpenter.* "After intently thinking, with closed eyes, on some particular colour, the retina becomes as exhausted by the image as if it had been exposed to an objective stimulus of colour"—*G. H. Lewes.* "If with closed eyes we keep before the imagination a bright-coloured object for a long time, and then suddenly open the eyes upon a white surface, we may see for an instant the imaginary object with a complementary colour."—*Th. Ribot.*

[2] "I have a distinct consciousness that in the internal representation of visible objects the same organs are at work which operate in the external perception of these; and the same holds good in an imagination of the objects of hearing, touch, taste, and smell. . . . But not only sensible perceptions, voluntary motions likewise are imitated in and by the imagination. I can in imagination represent the action of speech, the play of the muscles of the countenance, the movement of the limbs; and when I do this I feel clearly that I awaken a kind of tension in the same nerves through which, by an act of will, I can determine an overt and voluntary motion of the muscles."—*Sir W. Hamilton.* "In mentally recalling a verbal train we seem to repeat on the tongue the very words."—*Prof. Bain.*

[3] "The question of time necessary for the performance, so to speak, of an idea . . . is sometimes not less than the time required for the performance of a muscular movement."—*Dr. Maudsley.* "A musician can compress the keys of a harpsichord with his fingers in the order of a tune he has been accustomed to play in as little time as he can run over these notes in his mind."—*Dr. E. Darwin.*

Hence the sluggard, by going over and over again in thought something that he ought to do, may actually exhaust his physical powers more than if he had really done it, and that exactly in the same way.[1] Thus every act of memory is a physical act, accomplished through the operation of physical organs as much as is writing or speaking.[2]

But not only is every sensation produced, and its recall in idea attended by motion, but it is now an accepted doctrine of physiology that every thought that passes through the mind produces motion and change in the material organism of our bodies, particularly the brain.[3] This will be seen to naturally follow from what has been said, when we remember that there can be no thought or idea in the mind that has not originated in a

[1] "The long wavering deliberation has often cost more to feeling than the action itself, or a series of such actions would have cost; with the great disadvantage, too, of not being relieved by any of that invigoration which the man of action finds in the activity itself." —*John Foster.*

[2] "Memory . . . is a faculty so intimately associated with the operation of the vital forces, that no man doubts its entire dependence upon corporeal states."—*Dr. Laycock.* "We have in our own consciousness of effort, and in our experience of subsequent fatigue, a very strong indication that the power which thus controls and directs the current of thought is of the same kind with that which calls forth volitional contraction in the muscles, though exerted in a different mode."—*Dr. Carpenter.*

[3] "Just as no single action of the body takes place without the waste of some muscular tissue, so it is believed that no thought takes place without some waste of the brain."—*Prof. Drummond.* "Every action of the animal body, whether mental or muscular, is accomplished at the expense and accompanied by the destruction of a portion of the fabric of which it is composed."—*Dr. G. Holmes.* "A certain change of composition of the organized fabric is a necessary condition of every manifestation of its vital activity."—*Dr. Carpenter.* "It is admitted by all that every change in the consciousness is coincident with some vital change in the encephalon. . . . Without this vital change no mental phenomena whatever are manifested."—*Dr. Laycock.*

sensation.[1] Even our most abstract ideas, as of beauty or virtue, come to us from the contemplation of beautiful objects and virtuous actions.[2] It is natural, then, to suppose that as these beautiful objects and virtuous actions are produced and recalled by motion, so likewise must be the abstract ideas which are formed from them.[3] Indeed, we are of the opinion of those who hold that each specific thought has its specific seat in the brain, and that there is a constant and unvarying connection between the two.[4]

"There is nothing in the intellect that has not come to it through the senses but the intellect itself,—the rational power by which the material of the senses is raised into the region of intellectual ideas." —*J. D. Morell.* "All our ideas, like all our emotions, are reducible to a sensorial impression, as the fundamental condition of their occurrence. This sensorial impression is at the bottom of all our ideas, all our conceptions, though it may at first conceal itself in the form of a binary, ternary, quaternary compound."—*H. Spencer.*

[2] "In no case can an abstract word be rendered into thought without some one or more of the concrete meanings embraced by it being thought of."—*H. Spencer.* "Our idea of life is nothing but the idea of something living; of truth but of something true; of causation but of something causing; of time but of something lasting; of space but of something extended."—*S. Bailey.* "Every person can try for himself whether he has any conception of a general proposition called an abstraction without necessarily referring to external objects as examples."—*Dr. Büchner.*

[3] "If you wonder what organs of sense can be excited into motion when you call up the ideas of wisdom or benevolence . . . I ask you by what organs of sense you first become acquainted with these ideas?"—*Dr. E. Darwin.*

[4] "Every idea of the mind is associated with a corresponding change in some part or parts of the brain; and the physical changes in these parts give rise to a corresponding manifestation of ideas."—*Todd and Bowman.* "If every state of consciousness implies as an integral part a nervous action and if this action produces a permanent modification of the nervous centre, the state of consciousness will also be recorded in the same place and manner."—*Th. Ribot.* "I can hardly imagine that any profound scientific thinker, who has reflected upon the subject, exists who would not admit the extreme probability of the hypothesis, that for every fact of consciousness, whether in the domain of sensation, thought, or of motion, a

There is every reason to believe that the changes which result from these movements are not evanescent, that they do not vanish as soon as the causes by which they were produced have passed away, but that, on the contrary, they remain and form a permanent record of what has passed through the mind—a written testimony of all that each one has felt and thought and done in the past.[1] It cannot be supposed that the various particles that have been in agitation return to exactly the same condition as they were in before. Subsequent changes will no doubt affect, and, it may be, more or less modify or alter the effects of this one, but no subsequent change can possibly bring back the various particles to exactly the same condition in which they were before this change took place.[2] The change so effected is permanent, and constitutes, in our view, the physical

certain definite molecular condition is set up in the brain; that this relation of physics to consciousness is invariable, so that given the state of the brain, the corresponding thought or feeling might be inferred; or given the thought or feeling, the corresponding state of the brain might be inferred."—*Prof. Tyndall.*

[1] "It seems to be a legitimate conclusion that impressions made upon the organs of sense and transmitted to the brain produce some actual change in the minute organisation of the latter, and that this is subservient, and, in our present state of existence, essential to the memory."—*Sir B. Brodie.* "We seem justified in affirming that some change must be effected in the nervous centres by every impression of which we become conscious, whereby the impression is organically perpetuated in such a manner as to allow of its presenting itself anew to the cognisance of the mind at any future time."—*Dr. Carpenter.* "There can be no doubt that the registry of impressions involves an actual structural change in the ganglion, which is of a permanent character."—*Dr. Draper.*

[2] "Every impression leaves a certain ineffaceable trace; that is to say, molecules once disarranged and forced to vibrate in a different way, cannot return exactly to their primitive condition."—*Th. Ribot.* "When the organic modification has been once fixed in the growing brain, it becomes a part of the normal fabric, and is regularly maintained by nutritive substitution, so that it may endure to the end of life, like the scar of a wound."—*Dr. Carpenter.*

basis of memory.[1] In this way we believe that every good or evil thought we have ever entertained, every good or evil act we have ever done, is indelibly recorded in our bodily structure, to be brought back to mind, if not in this life, at least on the Great Day of Account, when our bodies will be raised and the deeds of all men made manifest.[2]

[1] "Every idea is a permanent, immutable impression in the brain, which may at any moment present itself anew if the mind be directed to it."—*Dr. J. Müller.* "Each impression we receive leaves a trace, a real physiological trace (*spur*) behind it, which may be revived and brought again into consciousness under the proper physical conditions."—*Dr. Beneke.* "In a brain that is not disorganised by injury or disease, the organic registrations are never actually forgotten, but endure while life lasts. No wave of oblivion can efface their characters. Consciousness, it is true, may be impotent to recall them; but a fever, a blow on the head, a poison in the blood, a dream, the agony of drowning, the hour of death, rending the veil between our present consciousness and these inscriptions, will sometimes call vividly back in a momentary flash, and call back, too, with all the feelings of the original experience, much that seemed to have vanished from the mind for ever."—*Dr. Maudsley.*

[2] "No sensation received, no judgment formed, no acquisition, no affection cherished, no passion gratified, will ever be found to have faded into nothing, as if they had never been. . . . Deem not this to be impossible. In the case of drowning, those who have been preserved and recover declare that the whole of their past lives did at that moment pass before them with the velocity of lightning."—*Dr. J. M'Crie.* Swedenborg describes the angels as after death examining a man's features and body in order to ascertain his actions and conduct in this world. Every thought and volition, he was informed, "is inscribed in the brain; for volition and thought have their beginnings in the brain, whence they are conveyed to the bodily organs, wherein they terminate. Whatever, therefore, is in the mind is in the brain, and passes from the brain to the body, according to the order of its parts. Thus a man writes his life in his physique, and thus the angels discover his autobiography in his structure."—A man's "character is written in his organisation, and might be read there, had we but senses acute enough to decipher the organic letters. There is not a thought of the mind, not a feeling of the heart, not an aspiration of the soul, not a passion which finds vent, not a deed which is done, that is not graved with an unfailing art in the structure of the body."—*Dr. Maudsley.* "This, perchance, is the dread Book of Judgment in whose mysterious hieroglyphics every idle word is recorded."—*S. T. Coleridge.*

The material impression or change that is effected in the structure of our bodies by every sensation we experience, every thought we think, and every action we perform, is not confined to the brain or any one part of the body, but extends to the several parts or organs that have been in activity. Each different kind of activity has its separate organs or parts through which it acts, and in which some change is effected by every action it performs.[1] This change is permanent, and constitutes, in our view, the physical basis of memory, which has thus as many distinct seats as there are different forms of activity.[2]

The senses are improved by being exercised, and this improvement is not confined to the brain, for the practised eye will see and the practised ear hear what these organs when untrained cannot distinguish;[3] and

[1] "A certain change of composition of the organised fabric is a necessary condition of every manifestation of its vital activity."—*Dr. Carpenter.* "It is a matter of daily observation that structure grows to the mode of its exercise . . . that is to say, that function develops structure in the line of its activity."—*Dr. Maudsley.*

[2] Since "memory is connected with the body, it must depend upon some change which must happen to the primitive state of the sensible fibres by the action of objects". It is "probable that the state of the fibres on which an object has acted is not precisely the same after this action as it was before. I have conjectured that the sensible fibres experience more or less durable modifications, which constitute the physics of memory and recollection."—*Chas. Bonnet.*

[3] "Let us take a particular case—a good visual memory, for instance. Its conditions are that the eye, the optic nerve, and those portions of the brain concurring in the act of vision, should be finely developed and act harmoniously. These structures, superior by hypothesis to the average, are perfectly adapted to receive and transmit impressions. Consequently the modifications of the nervous elements, as well as the dynamical associations which are formed, ought to be more stable, more definite, and easier to revive than those formed in a less favoured brain. . . . These remarks are applicable to hearing, smell, taste, and those diverse forms of sensibility comprised under the general term touch—in fact, to all the sense-perceptions."—*Th. Ribot.*

as with the senses so with the muscles. The efficiency and skill acquired by the handicraftsman in the use of his tools does not depend solely upon the brain and nerves, but includes also the muscles, which have become more adapted for the performance of their work by each repeated act of training they have undergone. Whatever parts, then, are concerned in the production of a sensation, the same parts are concerned in the recollection of it, which is simply a feebler form of the sensation;[1] and whatever parts are set in motion by an action, the same parts are necessary to the full and complete recollection of it, which is in reality an imperfect repetition of the action.[2] Thus the senses are not only necessary for receiving impressions, but are necessary also for imaging them in the memory; and the muscles are not only necessary for the performance of actions, but necessary also for the full remembrance of them.[3] Hence not the brain alone, but the whole body is the true seat of the memory.[4]

[1] "Sensations arising from within, as, for example, an idea of whiteness, are not indeed perceived with the full freshness of those raised by the actual presence of white light without us, but they are of the same kind; they are feeble repetitions of one and the same material brain process, of one and the same conscious sensation."—*Dr. E. Hering.*

[2] "Even when expressly using the powers of recollection, the mind seems almost consciously to be exerting itself on something *without*, which is imperfectly submitted to the will."—*Sir H. Holland.*

[3] "In a general way it may be said that the limbs and other sensorial organs of the adult act with facility only because of the sum of acquired and co-ordinated movements, which forms for each part of the body its special memory—the accumulated capital upon which it lives, and through which it acts, just as the mind lives and acts in the medium of past experience. To the same category belong those groups of movements of a more artificial character, which constitute the apprenticeship of the manual labourer, and are called into action in games of skill, bodily exercises, &c."—*Th. Ribot.*

[4] "There is memory in every . . . organic element of the body. . . . The manner in which the scar of a cut on a child's finger grows

The nature of the memory of a particular act or impression depends on the nature of the change which is effected in the parts concerned. It may make a deep or a slight impression, a clear or a blurred one. Much will depend on the degree of attention which the mind gives to it. When little, the impression will be slight, also when not regarded for a sufficient length of time. When mixed up with others, it will be blurred and indistinct. Much, too, depends upon the state of the body. In youth the body is easily impressed, and the impressions then made are lasting; whereas in old age impressions are formed with difficulty, and are difficult of recall.[1] When the body is exhausted by fatigue or by disease, or suffers from want of nourishment, the impressions will be slight and made with difficulty.[2] When, on the other hand, the body is fresh and vigorous, impressions are easily made, and are usually lasting. Whatever strongly excites the mind, or presents itself when the mind is under strong excitement, makes a lasting impression. If the curiosity is strongly excited about a thing, it readily fixes itself in the mind. Frequent repetition is, as everyone knows, a common way of fixing a thing in the memory. Hence in proportion

as the body grows, evinces, as Mr. Paget has pointed out, that the organic element of the part does not forget the impression that has been made upon it. . . . The permanent effect of a particular virus on the constitution, as that of smallpox or of syphilis, proves that the organic element remembers for the rest of life certain modifications which it has suffered."—*Dr. Maudsley.*

[1] "We find, for example, that new acquirements are easiest and most rapid during early life, the time of most vigorous growth of the body generally. We find also that rest and nutrition are as much needed for educating the organs as for keeping up the bodily health." —*Prof. Bain.*

[2] "Fatigue in any form is fatal to memory; the received impressions are not fixed; reproduction is slow, often impossible."—*H. Spencer.* No one "can go through a laborious recollection or train of reasoning when the body is exhausted and feeble".—*Sir H. Holland.*

as we exercise or cultivate any form of activity, we strengthen and improve the memory of it; that is to say, we multiply deeper and render more distinct the material traces on which the memory of it depends.[1]

As the mind is single, and each different form of activity has its distinct seat, it follows that if we wish to impress a particular subject or form of activity on the mind, we must do so by itself. Activities of the same kind are impressed, and stored up in the same parts; activities of different kinds in different parts. Hence when we attempt to carry on several new activities at the same time, it can only be done imperfectly and at great loss of power, by the mind passing rapidly from one seat to another. After the impressions are once formed, there is no difficulty in associating them together.

We have dwelt upon this because we think it of importance to establish the doctrine of the physical basis of memory.[2] There are many of its phenomena that it is impossible to explain unless we adopt this view, and by bearing it in mind we obtain light and leading on much that is otherwise dark and mysterious.[3]

[1] "The registering of experiences, it appears, is accomplished by a modification of the nervous structure. . . . The greater the amount of force brought to bear in affecting the nerves, the more complete and permanent will be the modification, and hence the more indelible will be the registry. The greater the quantity of sensation . . . the stronger will be the impression."—*D. G. Thompson.*

[2] "There is no part of our purely psychical activity the relation of which to physical conditions is more obvious and more intimate than that reproduction of past states of consciousness which . . . we call memory."—*Dr. Carpenter.* "The manifold disorders to which memory is liable illustrate in the most complete manner its organic nature."—*Dr. Maudsley.*

[3] "Whatever tends to produce a healthy state of brain in all its functions best contributes to repair default in the memory or recollective power."—*Sir H. Holland.* "It is possible that by accurate observation the proper means may be discovered of preserving tha

Thus when we try to recall something we have forgotten, we naturally go back in thought to the time or occasion when it was previously in the mind, and so recover it.[1] For instance, we meet a person in the street whom we remember to have seen somewhere before, but we cannot recollect where or when. We go over in thought the various occasions on which we think it likely we may have met him, and for a time it may be in vain; but at length we come upon the exact time: the whole scene at once flashes up before us, and we remember him perfectly. In this we resemble the person who, having lost a jewel or a piece of money or other valuable, goes to look for it in the place where he last had it or saw it.[2] In this case the object is material, and will, we know, remain in the place where it was left; but we find our thoughts and ideas also remaining where they were left, as if they, too, were material. Did we not succeed in recalling the particular occasion on

temperament of the brain which is favourable to memory, and of remedying the disorders of that temperament."—*Sir B. Brodie.*

[1] "Who has not, in order to recover an impression momentarily lost, made his way to the spot where the idea first arose, in order to place himself as far as possible in the same material situation; and at length find it suddenly revived?"—*Th. Ribot.* "If we would recover an absent idea, we may often do so by recalling those circumstances of time, place, company, &c., wherein we first observed, heard, or learnt it."—*Isaac Watts.* "If we wish to reproduce any sensational state . . . we first recall by recollection the notion of some object by which that state was formerly produced; and it is only by giving our attention strongly to that notion that we can bring ourselves to see, hear, smell, taste, or feel that which we desire to experience."—*Dr. Carpenter.*

[2] "Often when we do not immediately call to mind what we wish to remember, we set ourselves, as it were, to search for it: we meditate on other things or persons that seem to be like it, or contrary to it, or contiguous, or to bear any other relation to that we are in quest of; and thus, perhaps, we at last remember it." This "resembles the procedure of those who, missing something valuable, look for it in every place where they think they might have been when they dropped it, and thus recover what they had lost".—*Dr. Beattie.*

which we had previously met the individual, supposing we had done so only once, we should no more recollect him than the person would succeed in finding his lost jewel without going to the place where it actually was.

When we call to mind a past event, we do not recall it merely as a mental idea or impression, but we seem to see it again as we saw it at first, with all its attending circumstances, only with less distinctness. The beautiful castle I saw last summer I recall, not simply as an idea or by itself, but I seem to be again gazing upon it; and I see it now, as I saw it then, with the walks about it, the trees around it, the hills beyond, and the bright summer's sun shining overhead.[1] The one, indeed, appears to have not a little of the materiality of the other; nor is this to be wondered at when we remember that all that I perceived in the first case was certain impressions made by the action of light upon the retina of my eye, and that in all probability the same parts are affected in the recalled impressions as were concerned in the original ones.

Further, with regard to a past impression, we can not only assert that it was in the mind before, but we can usually fix the exact time when it was so. We can say, for instance, that it was last week or last month or five or ten years ago. In endeavouring to determine the

[1] "When I recall an object of sight by the power of memory, it appears to me precisely the same as in the original survey, only less distinct. For example, having seen yesterday a spreading oak growing on the bank of a river, I endeavour to recall these objects to my mind. How is this operation performed? Do I endeavour to form in my mind a picture of them or representative image? Not so. I transport myself ideally to the place where I saw the tree and river yesterday; upon which I have a perception of these objects similar in all respects to the perception I had when I viewed them with my eyes, only less distinct. And in this recollection I am not conscious of a picture or representative image more than in the original survey the perception is of a tree and river, as at first."—*Lord Kames.*

time when it occurred we may perhaps call to mind one event, and say it was before that, and another, and say it was after that, till we come upon the exact time; precisely in the same way as we can turn to a particular passage in a book we have read. The treasures of our memory would thus seem to be laid up in distinct layers or recorded in consecutive pages like the matter of a book.[1] Thus children who have learnt to speak in several languages never confuse them. When asked a question in one language they always reply in that language.

Hence in recollection the great difficulty usually is to make a beginning—to get the first word of a sentence, the first letter of a word, something that will lead us to the right place, or set the mind on the right groove—and then it will run on with little difficulty. We sometimes search the memory in vain for a thing for a long time till we come upon some link—a word, it may be, or a name—and then all at once the whole thing flashes up before us. A friend tries to bring to our recollection something that happened long ago—some school-boy exploit, it may be, in which we took part. We fail to recall it till he mentions a particular circumstance, or names some one who was present, and then all at once the whole scene is brought vividly to our recollection, as if it had happened only yesterday.[2]

[1] "The exact observance of the order of place in visible ideas, and of the order of time in audible ones, may serve to show that these ideas are copies and offsprings of the impressions made on the eye and ear, in which the same orders were observed respectively." —*Dr. D. Hartley*.

[2] It is related of a distinguished equity judge that, in listening to the further proceedings in a case that had previously been before him, he had no recollection of it till, "in the course of the argument, some word, phrase, or incident has furnished a suggestion that has served at once to bring the whole case vividly into his recollection, as if a curtain had been drawn away and a complete picture presented to his view".—*Dr. Carpenter*.

We may have striven to recollect something for long time in vain, and afterwards it may occur to u suddenly when perhaps we are not thinking of it having, as it were, come unexpectedly upon the plac where it lay.[1] Sometimes, again, it may be said tha we were told something or other, and we may be un conscious of ever having heard it before, and yet per haps, days or weeks afterwards, through the accidenta shining in, as it were, of light on some dark corner c the memory, the circumstance may be brought to ou recollection.

In endeavouring to recover a lost idea, we sometime seem to know what or where it is, and yet we fee unable to get at it or grasp it. Numerous other ideas more or less, it may be, resembling it or related to it come up, and they seem, as it were, to obstruct o hinder our getting at the right one. We feel that i we could get away from these, or banish them fron the mind, we would get nearer to what we are in searcl of. Hence some have said that forgetfulness is nothing but the remembrance of wrong ideas, or the presenc in the mind of ideas other than those we are seeking At all events, forgetfulness is an important condition c memory, and we must temporarily forget many thing in order to remember some things well.[2]

[1] "Once lodged in the brain or mind, an impression may lie dor mant indefinitely, until some discharge of mental force or energ happens to take place through the particular layer or stratum c corpuscles which embodies the record of the idea."—*Dr. M. Granvill*

[2] "If our impressions of the past were not . . . liable to b abated, borne down, or obscured and obliterated, there would i most minds be certain vivid recollections that would continue t usurp the entire consciousness, and so exclude the present with i fainter sensations, its interests, and its duties."—*Isaac Taylo* "Without the total oblivion of an immense number of states of con sciousness, and the momentary repression of many more, recollectic would be impossible."—*Th. Ribot.*

CHAPTER II.

MATTER AND MIND.

"The popular or habitual conception of mankind in general is that there are vo distinct worlds, mixed up in the phenomenal cosmos—a world of mind, consting of multitudes of individual minds, and a world of matter, consisting of l the extended immensity and variety of material objects."—*Prof. Masson.*

"What matter is independent of our perception, what mind is independent its temporary varieties of feeling, it is impossible for us to discover."—*Dr. hos. Brown.*

"We cannot tell what matter is in itself or what spirit is in itself; but we ean by matter that which has length, depth, and breadth,—the properties which e revealed to us by our outward senses; we mean by spirit that which is not ound to the conditions of space, which is not known to us by our bodily senses mediately, but by a revelation *sui generis* called consciousness."—*S. T. Coleridge.*

"What I call my body is a persistent aggregate of objective phenomena,—and y soul is a persistent aggregate of subjective phenomena: the one is an individualised group of experiences expressible in terms of matter and motion, and erefore designated *physical;* the other an individualised group of experiences pressible in terms of feeling, and therefore designated *psychical.*"—*G. H. Lewes.*

CLAIMING as we do a material basis for the memory, we deem it necessary to explain at some ngth what we understand thereby, especially as it is subject on which no little ignorance and prejudice ommonly prevail. What matter is by itself or what ind is by itself, we know and can know nothing. ertain phenomena, or appearances, present themselves our bodily senses, and we attribute them to matter; ertain other phenomena reveal themselves to our inner nse, or consciousness, and these we attribute to mind. Vere we endowed with more senses than we have at resent, or were those we now possess more powerful an they are, we cannot doubt that our knowledge the so-called material world would be greatly ex-

tended, and probably much that we now regard a mental might be found to be the result of physica causes; and, on the other hand, were our conscious ness much extended so as, for instance, to take cogniz ance of some of those material changes which we know to accompany every thought that passes through the mind, we might find mind to be much more dependen upon physical causes than is generally believed a present.[1]

Formerly, when consciousness reigned supreme, and was regarded as the ground of all our knowledge, the world of mind was everything, that of matter as nothing in comparison. "On earth," said the philosopher "there is nothing great but man; in man there is nothing great but mind." Men then talked with pride of the mastery achieved by mind over matter, which was compelled to submit its gigantic powers to its will and from being an uncontrollable tyrant to become the most submissive and obedient of servants. Every fresh victory gained over matter seemed only to bring ou more clearly the unlimited power of mind, and to hol it up as the one thing worthy of supreme regard.

This, however, is no longer the case. Men hav discovered that every thought that passes through th

[1] "We have no reason for believing that the sensibility of th mind of man exhausts the properties of matter or is percipient of al possible forms of existence in space. Other senses might make nev discoveries no less surprising than the sense of sight to one who ha been born blind. It is even conceivable that substances may exis contiguous to us in space, yet be as nothing to us, because their pro perties bear no relation to our sensibility."—*R. A. Thompson.* "Th addition of one new sense . . . might probably, in a few hour communicate more instruction with respect to matter, than all whic is ever to repay and consummate the physical labours of mankind. —*Dr. Chalmers.* "Consciousness gives no account of the essenti material conditions which underlie every mental manifestation an determine the character of it."—*Dr. H. Maudsley.*

mind is attended with a material change in certain particles of the body; so that without some material change no conscious act of the mind can take place.[1] Hence some of the ablest thinkers in the present day declare that there is no such thing as mind in the world apart from matter; that mind is simply the result of a certain combination of matter, or that matter and mind are only different sides of one and the same substance.[2]

This much is certain, that matter and material laws are largely concerned in all the phenomena of mind, and the broad distinctions that were formerly believed to exist between the two no longer hold good.[3]

[1] "In the present condition of our nature, the human mind is connected with a material and organised substance, the body, with which its operations stand in a state of union so close, perfect, and necessary, that neither can act without the action, direct or indirect, of the other."—*Dr. Pye Smith.* "Mind can only manifest itself in existence as it acts upon matter; without matter there can be no manifestation of mind."—*Dr. Laycock.* "Every idea, voluntary or not, clear or obscure, complex or simple, fugitive or persistent, implies a determined molecular movement in the cerebral cells. . . . There is no exception to this rule, the loftiest thought, the most abstract conception, is subject to it."—*H. Taine.*

[2] "The arguments for the two substances have, we believe, now entirely lost their validity; they are no longer compatible with ascertained science and clear thinking. The one substance, with two sets of properties, two sides, the physical and mental—a double-faced unity, would appear to comply with all the exigencies of the case."—*Prof. Bain.* "Psychological analysis leads to the conclusion that the objective process and the subjective process are simply the twofold aspects of one and the same fact; in the one aspect it is the felt, and the other the feeling."—*G. H. Lewes.* "Reduced to one single fact possessed of two aspects they evidently become like the front and reverse side of a surface, so that the presence or absence of the one will infallibly result in the presence or absence of the other."—*H. Taine.*

[3] "The purest, the most ideal sentiment still pertains on some side, to organisation. The inspiration of the poet, the passion of the lover, the enthusiasm of the martyr have their languors and shortcomings that often depend on very pitiable material causes."—*V. Cousin.* "The pluck by which the British soldier is especially distinguished is clearly as much physical as psychical." —*Dr. Carpenter.*

Consciousness, to which we are indebted for our knowledge of mind, gives us no information respecting those bodily conditions on which we know that all our mental manifestations depend, or of those molecular movements that attend every act of the mind. While I am conscious of seeing an object before me, I am quite unconscious of the change that has taken place on the retina, or of the movements occasioned in the nerves and brain before it can be apprehended by the mind.[1]

Even with regard to its own domain, consciousness affords us but very imperfect information. It instructs us indeed respecting those sensations, thoughts, or emotions that may be directly present to the mind, but it tells us nothing of what is constantly going on in that much vaster ultra-conscious region where the higher operations of the mind are carried on, and where reside thoughts, feelings, and emotions which largely, though unconsciously, influence our daily life and animate our conduct. Consciousness tells a man that he is a free agent; but beyond the sphere of consciousness there are influences with which he has to reckon, and reason and statistics go to prove that he is by no means so free as he believes himself to be. (See Chapter VI. "Mind Conscious and Unconscious".)

The true explanation of the difficulty, or rather to us the impossibility, of bridging over the gulf that separates matter and mind seems to be that the information we receive respecting them reaches us through

[1] "Consciousness, which cannot even tell us that we have a brain, is certainly not capable of making known the different brain-changes that go along with its manifold affections."—*Dr. Maudsley.* "Independently of observation of the external mechanism, and of anatomical research, he is wholly ignorant that he has a brain, or nerves, or heart, or stomach, or lungs, or eliminating organs, and *a fortiori* of the working or functions of those organs."—*Dr. Laycock.*

lifferent channels.[1] The phenomena of mind are re-
'ealed to us by a different sense, come to us through a
lifferent route, from those through which we receive
ur knowledge of the outer world. As in the case of
ur bodily senses, we cannot by one sense apprehend
he qualities belonging to another,—cannot, for instance,
ear a colour, or taste or smell a colour, any more than
re can see a sound, or taste or smell a sound,—so we
elieve that it is impossible for us, as at present con-
tituted, to apprehend any of the phenomena of con-
ciousness by our bodily senses, or material phenomena
y consciousness alone, apart from our bodily senses.[2]
The passage from the physics of the brain to the
orresponding facts of consciousness is," says Professor
'yndall, "unthinkable. Granted that a definite thought
nd a definite molecular action of the brain occur simul-
ineously, we do not possess the intellectual organ, nor
pparently any rudiment of the organ, which would
nable us to pass by a process of reasoning from the
ne phenomenon to the other." Were we possessed of
l knowledge, so that we could look nature through
nd through, all its parts would doubtless be seen to be

[1] "The gulf between the conception of the movements of cerebral
olecules and the self-consciousness of will-energy, may well be due to
le different ways of acquiring them; molecular motion and will being
e and the same event seen under different aspects."—*Dr. Maudsley.*

[2] "When we examine closely the idea of a sensation and the idea
a molecular movement of the nervous centres, we find that they
ter by routes not merely different but contrary. The first comes
om within without any intermediate, the second comes from with-
t through several intermediates. . . . One and the same single
ent known in these two ways will appear double; and whatever
the link which experience establishes between its two manifesta-
ns we shall never be able to convert one of them into the other.
cording as its representation comes from without or within, it will
variably appear as *a thing without* or *a thing within*, and we shall
ver be able to reduce that which is without to that which is within,
that which is within to that which is without."—*H. Taine.*

connected and interdependent, and mind and matter might then be found to be after all but two sides of one and the same substance.[1] "Man," says John Milton, "is a living being intrinsically and properly one and individual, not compound or separable,—not, according to the common opinion, made up and framed of two distinct and different natures, as of soul and body."[2]

This, which is properly a scientific question, has unfortunately been too often regarded as a theological one, and the doctrine of the materiality of the mind or soul held to directly involve its immortality. "The principle," says Dr. Abercrombie, "seems to have been too much lost sight of in the discussion of this subject that our speculations respecting the materiality of the rational human soul have no influence on our belief of its immortality. This momentous truth rests on a species of evidence altogether different, which addresses itself to the moral constitution of man. . . . Though we were to suppose, with the materialist, that the rational soul of man is a mere chemical combination which, by the dissolution of its elements, is dissipated

[1] "When we find within us two ideas which have entered by different routes, we ought to mistrust the tendency which induces us to assert a difference and, above all, an absolute difference between their objects. . . . It is possible then that the sensation and the internal movement of the nervous centres may be at bottom one and the same unique event condemned by the two ways in which it is known always and irredeemably to appear double. . . . There is nothing to prevent the molecular movements from being the infinitesimal elements of the whole sensation."—*H. Taine.* "It is we who make separate sciences in consequence of the constitution of our faculties limiting our channels of apprehension to a few special points of contact with the external."—*Dr. Maudsley.*

[2] "The union of the soul and body appears to me essential and indissoluble. Man without a body is, in my opinion, man no longer, and God has thought and willed him embodied, and not otherwise. . . . According to this passage (in Genesis), we cannot doubt that the body or a body is essential to human personality and to the very idea of man."—*A. Vinet.*

o the four winds of heaven, where is the improbability hat the Power which framed the wondrous compound nay collect these elements again and combine them .new for the great purposes of his moral administra-ion?" To the same effect John Locke says: "All the reat ends of morality and religion are well enough ecured without philosophical proofs of the soul's im-nateriality, since it is evident that He who made us at irst begin to subsist here sensible, intelligent beings, nd for several years continue us in such a state, can nd will restore us to the like state of sensibility in nother world, and make us capable there to receive he retribution He has designed to man according to heir doings in this life". "Milton's conclusion is that t the last gasp of breath the whole man dies, soul and ody together, and that not till the Resurrection, when he body is revived, does the soul live again, does the nan or woman live again, in any sense or way, whether or happiness or misery."—*D. Masson.*[1] "That the spirit f man should be separate from the body, so as to have perfect and intelligent existence independent of it, is owhere said in Scripture, and the doctrine is evidently t variance both with nature and reason."—*John Milton.*
The great distinguishing doctrine of Christianity is ot the immortality of the soul, but the resurrection of he body.[2] That the soul of man is immortal was a

[1] "Are the souls of the millions on millions of human beings who ive died since Adam, are those souls already either with God and e angels in heaven or down in the diabolic world, waiting to be joined to their bodies on the Resurrection Day? They are *not,* ys Milton; but souls and bodies together, he says, are dead alike, eeping alike, defunct alike, till that day come."—*D. Masson.*

[2] "Though mankind have at all times had a persuasion of the imortality of the soul, the resurrection of the body is a doctrine eculiar to Christianity, and met with no little opposition even in te apostolic age."—*Dr. James Beattie.*

common belief among the Ancients, from whom it foun its way at an early period into the Christian Church but the most influential of the early Fathers wer strenuously opposed to it, holding that the human sou was not essentially immortal, but only, like the body capable of immortality. "God alone," says Justi Martyr, "is uncreated and incorruptible; but all othe things beside Him are created and perishable. Fo this reason souls both die and are punished."[1]

Some theologians are apt to expatiate on the sinful ness of the flesh, the worthlessness of the body, a contrasted with the purity of the spirit, the value o an immortal soul. But this is to misunderstand th teaching of Scripture, and to separate what God ha inseparably joined together in this life, and will unit for all eternity in the world to come.[2] "The origina

[1] "The belief that the soul is inherently immortal belongs to th old-world philosophy, and found its way at a later period int Christian theology," but "the leading teachers of the early Churc Justin Martyr, Theophilus of Antioch, Irenæus, Arnobius, Atha nasius, and others, taught that the human soul, as at first create is not necessarily mortal or inherently immortal, that it is capabl both of mortality and immortality, and that it lives as long as Go wills, or returns when He wills to that state in which it was befor its birth."—*D. Milne.* "Some of the most influential of the earl Christian writers were materialists, not as holding the soul to b the mere result of bodily organisation, but as holding the soul itse to be material—corporeal. . . . It appears that in those days th vulgar held the soul to be incorporeal, according to the views Plato and others, but that the orthodox Christian divines looke upon this as an impious, unscriptural opinion. Justin Marty argues against the Platonic nature of the soul."—*S. T. Coleridg* (See also *Edward White: Life in a Risen Saviour.*)

[2] "The immortality of the Gospel is not simply the immortalit of the soul, it is the immortality of humanity. It is man that is live hereafter, and whose whole nature, so to speak, is to be pe petuated for ever."—*T. Binney.* "The souls of the blessed shall n only be glorious, but their very bodies shall be filled with glory."- *Jeremy Taylor.* "You live again in the body,—in the very body to all essential properties, and to all practical intents and purpo in which you live now. . . . I am to live not a ghost, a spectre,

natter of which we speak," says Milton, "is not to be ooked upon as an evil or a trivial thing, but as intrinsically good and the chief productive stock of every subsequent good." "The union with matter, or the coming into a corporeal state, may be in fact not a legradation to mind, but the very means of its quickening, its birth into the world of knowledge and action. . . A little attention to what is involved in the idea of corporeal existence will incline us to believe that it s the basis of intellectual activity, of moral agency, and f communion or sociality among intelligent orders."—*Isaac Taylor.*

The question more immediately before us, however, s: Does the mind or spirit of man, whatever it may e, in its actings in and through the body, leave a naterial impression or trace in its structure of every onscious action it performs, which remains permaently fixed, and forms a material record of all that it as done in the body, to which it can afterwards refer s to a book and recall to mind, making it again, as it ere, present to it? "Why," asks Dugald Stewart, should it be imagined that any step is made towards aterialism by supposing that an invisible book exists the sensorium, by the interpretation of which we re enabled to perceive external objects, and by a eference to which we recover as in a tablet the knowdge which has happened to escape from the memory?" The question," he continues, "it ought always to be membered, is not about the nature of the thing read, ut about the nature of the reader."

irit, I am to live then as I live now, in the body."—*Dr. R. S. ndlish.* "I think that the Christian doctrine of the Resurrection eets the materialists so far as this—that it does imply that a body an organisation of some sort is necessary to the full development man's nature."—*Dr. T. Arnold.*

In speaking of matter and material impressions i connection with memory, we would not be understoo to mean anything that can be perceived by or mad apparent to the senses. When we think of matter w usually imagine it as something that can be appre hended by the senses, or by some of the mechanica aids which we employ to extend their powers. We rarel think of the material kingdom as extending vastl beyond the utmost limits that we are able to reach b such means, and that all the properties which we attri bute to matter stretch immeasurably beyond our utmos ken.[1] In general, then, we may say that we infer th existence of matter where we find properties manifeste that we know to belong to it.

The minuteness of the particles of bodies that may b perceived by the senses has often been dwelt upon Thus a grain of musk has been kept freely exposed t the air in a room the doors and windows of which wer constantly open for a period of ten years, during whic time the air thus continually changed was completel impregnated with the odour, and yet at the end of tha time the particle was not found to have diminished pe ceptibly in weight. The taste of strychnine is apparer

[1] "There can be no doubt that there is as much in the anim structure beyond the reach of the microscope as there is in the va universe around us beyond the reach of the telescope."—*Sir B. Brod* "This present visible universe no more exhausts the totality of thin in space than it does in time; around it, and beneath it, and with it are modifications of material existence, of which we can form on a very vague conception."—*Dr. C. Beard.* "The intimate research of modern physical science leave no room to doubt that there a many agencies in activity about us which, although they ma themselves known in their ultimate consequences, are not direct cognizable either by the eye, the ear, the touch, the taste, or t smell."—*Isaac Taylor.* "We cannot detect the difference betwe the nerve element of a brain exhausted by exercise and incapable further function, and that of a brain reinvigorated by sleep and rea for a day of energetic function."—*Dr. Maudsley.*

when diluted to one in a million. "Animalcules have been discovered . . . so diminutive that a million of them do not exceed the bulk of a grain of sand, and yet each of these creatures is composed of members as curiously organised as those of the largest species. They have life and spontaneous motion, and are endowed with senses and natural impulses."—*Dr. Hands*.

We find nature everywhere around us recording its movements and marking the changes it has undergone in material forms,—in the crust of the earth, the composition of the rocks, the structure of the trees, the conformation of our bodies; and those spirits of ours, so closely connected with our material bodies, that, so far as we know, they can think no thought, perform no action, without their presence and co-operation,[1] may have been so joined in order to preserve a material and lasting record of all that they think and do,—a witness for or against us on the Great Day of Account for which, as we are told, our bodies will be raised.

If we examine a portion of the earth's crust, we find legibly imprinted there marks of changes that have taken place in it, perhaps myriads of ages ago. At one time perhaps it was under the sea; at another it formed the bottom of a fresh-water lake; upheavals took place, and we can note the periods of them; glaciers passed over it, and we observe their scratches. At one time it

[1] "Every human movement, every organic act, every volition, passion, or emotion, every intellectual process, is accompanied with atomic disturbance."—*G. P. Marsh*. "The soul never does one single action by itself apart from some excitement of bodily tissue."—*J. A. Picton*. "We can no more realise mind as acting apart from matter than we can realise the force of gravity or of chemical affinity as acting apart from matter."—*Dr. Laycock*.

may have been covered with a tropical vegetation; at another it may have experienced the rigours of an Arctic climate.[1] An animal of a species long since extinct once went to slake its thirst at a river, and we clearly see its footprints in what was then soft clay or mud, but is now hard rock. So, too, in the rocks we find the marks of rain-drops and water-ripples originally formed in the soft sand. An animal died, a tree fell, a leaf dropped, thousands of ages ago, and to-day we can trace their remains with the greatest minuteness.[2]

The hoary tree that has stood for centuries by the wayside bears in its structure a material record of every year of its existence. Even with our dull and limited senses, we can there read something of its past history and of the changes it has undergone; but may we not well believe that to Higher Intelligences there may be perceptible traces of every storm it experienced, of every blast that blew on it, of every sun that shone on it, of every atmospheric change that affected it? May not the vows softly whispered under its branches, and

[1] "The rolling rock leaves its scratches on the mountain; the river its channel in the soil; the animal its bones in the stratum; the fern and leaf their modest epitaph in the coal. The falling drop makes its sculpture in the sand or stone. . . . The ground is all memoranda and signatures, and every object covered over with hints which speak to the intelligent. In nature this self-registration is incessant."—*R. W. Emerson.*

[2] "Myriads or millions of years ago the tide was out and the beach was smooth and soft and flat, and there fell a shower of rain and pitted the surface in a particular way. . . . Then came a little salt-water lizard, or a crab sidling along, or a frog the size of a well-fed pig, leaping and waddling by turns; and on the micaceous mud each inscribed the whole history of that day's proceedings; . . . and there it remained till the tide gently rose and with fine sand or clay filled up the impressions. And now that the whole is converted into rock, there comes some exploring Miller or Mantel and turns over the stony leaves, and reads the record as plain as if it had been printed yesterday."—*Dr. James Hamilton.*

heard by no human ear save one, be found there recorded in permanent characters?[1]

It is now an established fact that the sun's rays cannot fall upon any object without producing a molecular disturbance or chemical change—a change which is permanent, and may even be made visible by resorting to proper means. All photographic pictures are of this kind. But not only prepared surfaces, but the surfaces of all material things are constantly undergoing a mysterious change while under the influence of sunshine. Lay a key upon a sheet of white paper exposed to the sun's rays, then place the paper in a dark drawer, and the spectral image of the key will still be visible after the lapse of years. "If," says Dr. Draper, "on such inorganic surfaces impressions may in this way be preserved, how much more likely is it that the same thing occurs in the purposely constituted ganglion."

Owing to the changes that are constantly taking

[1] "No atom can be disturbed in place or undergo any change of temperature, of electrical state, or other material condition, without affecting, by attraction or repulsion, or other communication, the surrounding atoms. These, again, by the same laws transmit the influence to other atoms, and the impulse thus given extends through the whole material universe." Hence "there exists, not alone in the human conscience or in the omniscience of the Creator, but in external material nature, an ineffaceable, imperishable record, possibly legible to even created intelligence, of every act done, every word uttered, nay, of every wish and purpose and thought conceived by mortal man from the birth of our first parents to the final extinction of our race".—*G. P. Marsh.* "The air itself is one vast library, on whose pages are for ever written all that man has ever said or woman whispered. There in their mutable but unerring characters . . . stand for ever recorded vows unredeemed, promises unfulfilled; perpetuating, in the united movements of each particle, the testimony of man's changeful will. . . . Whilst the atmosphere we breathe is the ever-living witness of the sentiments we have uttered, the waters and the more solid materials of the globe bear equally enduring testimony of the acts we have committed."—*C. Babbage.*

place in our bodies as well as in living organic matter generally, the traces or marks of impressions once received would soon disappear but for the fact that the existing particles impart their form and character to those that come after them.[1] A cut finger retains the marks of the injury it has sustained long after the wound itself is healed. The same cells do not remain, but are constantly being carried away and their places supplied by others; but the injured cells retain and transmit to their successors the form and character impressed upon them by the injury, and so in generation after generation of cells the memory of the injury once sustained is kept up.[2]

Every part of the body, every cell and every fibre, has a life of its own as well as contributing to the life of the individual.[3] Each lives, produces after its kind,

[1] "It is asked how can the brain be the organ of memory when you suppose its substance to be ever-changing? . . . The answer is because of the exactness of assimilation accomplished in the formative processes: the effect once produced by an impression upon the brain, whether in perception or in intellectual act, is fixed and there retained, because the part, be it what it may, which has been thereby changed, is exactly represented in the part which in the course of nutrition succeeds to it."—*Sir James Paget.*

[2] "The formative process exactly assimilates the new materials to the old. . . . The new formed blood and tissues take the likeness of the old ones in all their peculiarities, whether normal or abnormal." Thus "after any injury or disease by which the structure of a part is impaired, we find the altered structure, whether an induration, a cicatrix, or any other, as it were, perpetuated by assimilation. It is not that an unhealthy process continues: the result is due to the process of exact assimilation operating in a part of which the structure has been changed. The same process which once preserved the healthy state maintains now the diseased one."—*Sir James Paget.*

[3] "There is . . . a life of the parts and a life of the whole organism; each microscopic cell has its independent existence, runs its own career from birth to death; and the sum total of such lives form what we call the life of the animal. The unity is the aggregate of forces, not one presiding force."—*G. H. Lewes.* "Every cell in the

and dies. Its successors live, produce after their kind, and die; and so with others. At first, during infancy and childhood, each succeeding issue becomes stronger and more vigorous than the preceding; but after a time, in maturity, they become stationary, and eventually degenerate and die out. They are likewise subject to disease and to premature decay.

In the hereditary transmission of qualities we seem to have a remarkable parallelism to what is thus constantly taking place in our bodies. The individual cell imparts its form and character to that which takes its place, and the parents impress their physical and mental qualities upon their offspring. That mental qualities are transmitted from parents to children is evidently owing to the brain, the physical organ of the mind having, like the other parts of the body, a transmitted nature.[1] Thus we find properties or qualities which have been acquired by the parents, and been, as we believe, imprinted in their physical structure, appearing as innate qualities in their offspring.[2] In

organism is independent. It is born, it grows, it produces, it dies, as if it were a single celled plant or animal. . . . Just as the life of a nation or a tree is the sum total of the lives of all its individual parts, so is the life of an organism the sum total of the lives of its individual cells."—*Ditto.*

[1] "Hereditary transmission, displayed alike in all the plants we cultivate, in all the animals we breed, and in the human race, applies not only to physical but to psychical peculiarities."—*H. Spencer.* "Whenever the transmission of insanity occurs, we are bound by all analogy to infer the presence of a morbid, material cause upon which the phenomena primarily depend."—*Sir H. Holland.* "The health of the mind . . . is subject to the same laws as is the health of the body. For the brain, the organ of the mind, grows and is maintained according to the same method of nutrition as every other part of the body; it is supplied by the same blood, and through the blood, like every other part, may be affected for good or ill by the various physical influences to which it is exposed."—*Sir J. Paget.*

[2] "The greater exactness of modern observation is ever placing before us new and wonderful instances in which the most minute

other words, we find marks or traces of deeds done by the parents appearing in the children, and manifesting themselves as unconscious hereditary memory.[1] Nor is this confined to parents, but may extend to more remote ancestors.

May not the descendants of one common stock be regarded as parts of one great organism, linked together by bonds of relationship closer and more intimate than is commonly supposed?[2] Only on this principle are many of the phenomena to be observed in the physical and moral worlds to be explained; and it shows a paramount duty devolving upon parents of having a

peculiarities or defects in structure and function are transmitted from one generation to another."—*Sir H. Holland.* "Acquired habits in several successive generations become permanent and assume the character in instincts. . . . We must suppose that the conversion of an acquired habit into an instinct is attended with some actual change in the organisation of the brain."—*Sir B. Brodie.*

[1] "The true type of organic memory . . . must be sought in the group of facts, to which Hartley has given the appropriate title of secondary automatic actions, as opposed to those automatic functions which are primitive or innate." W may go lower: "the exercise of each of our faculties (sight, touch, locomotion) implies a completely organic memory". "Can we go farther? We can. Below the compound reflex impressions representing organic memory at its lowest term, there are simple reflex impressions. These resulting from innate anatomical conditions, have been acquired and fixed by long continued experience in the evolution of species. We thus pass from individual to hereditary memory which is a specific memory." —*Th. Ribot.*

[2] "The offspring is termed a new animal, but is in truth a branch or elongation of the parent, since a part of the embryo animal is or was a part of the parent, and therefore in strict language cannot be said to be entirely new at the time of its production, and therefore it may retain some of the habits of the parent system."—*Dr. E. Darwin.* "Every organism imparts to the germ that issues from it a small heritage of acquisitions which it has added during its own lifetime to the gross inheritance of its race."—*Dr. E. Hering.* "The successive lineal descendants of any one kind of organism may in effect be regarded as portions of the same organism gradually developing through successive generations or stages of one life history."—*Dr. Bastian.*

constant regard in their conduct, to the effects it may have on the characters of their children.[1] (See *Education and Educators*, Chapter IV., "The Hereditary Effects of Education".)

[1] "Taking this comprehensive view of the organic unity of successive generations of men . . . it shows the past descending on the present, the present on the future, by an inevitable law, and yet gives every parent the hope of mitigating the sad legacy of mischief he entails upon his children by whatever improvements of character and conduct he is able to make."—*Dr. H. Bushnell.*

CHAPTER III.

THE BODY.

"Die Mittel wodurch die Seele . . . mit der aeussern gegenständlichen Welt in Verbindung tritt, ist eigentlich der ganze Leib, durch den und dessen Organe sie Eindrücke von Aussen empfängt und Bewegung noch Aussen hervorbringt."—*Dr. J. Beck.*

The mind "depends for the manifestation of all its activities upon a material organism".—*J. D. Morell.*

"It appears to me that the frame of the body . . . is a complex organ, I shall not say of sense, but which ministers, like the external senses, to the mind; that is to say, as the organs to the five senses serve to furnish ideas of matter, the framework of the body contributes in certain conditions to develop various states of the mind."—*Sir Charles Bell.*

"The organ of the mind is not the brain by itself: it is the brain, nerves, muscles, organs of sense, viscera. . . . It is uncertain how far even thought, reminiscence, or the emotions of the past and absent could be sustained without the more distant communications between the brain and the rest of the body,—the organs of sense and movement."—*Prof. Bain.*

THE body is that part of man's nature which brings him into connection with the material world. It is by means of bodily organs, the senses, that the mind acquires its knowledge of the world around it; and it is through its various organs of motion that it acts upon and impresses outward nature, and communicates its thoughts and feelings to others.[1] In addition to this

[1] "Sensation and volition are the two functions by means of which the mental principle is enabled to maintain its communication with the external world. It is under the influence of volition that the contraction of muscles takes place for locomotion, speech, the procuring of food, and other purposes. . . . Here there is an impulse communicated from the mind to the brain, from thence to the nerves, and from these to other organs, and producing a marked change in the condition of the latter; and *a priori* there is no reason to doubt that the operation of a similar cause may produce an equal change, though of another kind and more permanent, in the minute structure of the brain itself."—*Sir B. Brodie.*

all the mind's operations are carried on through a material organ, the brain, which is subject to the same laws and conditions as the other parts of the body. Such is the close and intimate connection which subsists between mind and body in man, that no thought passes through the mind without a corresponding bodily movement, on which it depends for its manifestation in consciousness.[1] Hence we are of opinion that more light is to be obtained respecting the mental phenomena from the study of the physical constitution than in any other way.[2]

There are few writers on Memory who do not admit that it is the faculty of the mind that is most dependent on physical conditions.[3] The almost universally-

[1] "Mind can only manifest itself in existence as it acts upon matter; without matter there can be no manifestation of mind."—*Dr. Laycock.*

[2] "I am persuaded that the only possible route to truth in mental philosophy is through a study of the nervous mechanism. . . . The advancement of metaphysics is through the study of physiology."—*Dr. Draper: Human Physiology.* "The mind is so intimately dependent upon the condition and relation of the organs of the body, that if any means can ever be found to render men wiser and more ingenious than hitherto, I believe that it is in medicine they must be sought for."—*Descartes.* "Physical decline and moral depravity are intimately connected, and those laws which are requisite for the preservation of health serve also to preserve and improve the morals. . . . In a word, our moral health and energy are commonly the result of our physical health and strength; and our moral failings are often nothing more than consequences of our bodily defects. Good actions alone render men truly moral and virtuous. This requires power of action, and for this the body must be strong and active."—*Sir B. Brodie.* "The cause of morality—of everything that is connected with the onward movement of the race—is more dependent upon the bodily health, upon the organic soundness of the human constitution, than many politicians, moralists, and divines seem ready to believe."—*Dr. John Brown.*

[3] "Of all the intellectual powers, it (memory) depends most on the organised structure for whatever concerns its completeness, its changes, and decay."—*Sir H. Holland.*

received opinion, however, is that it depends upon traces left in the brain; while we, on the other hand, hold that the traces are not confined to the brain, nor even to the nervous system, but extend to those other parts of the body that were concerned in the original impression. Every act we do, every sensation we experience, every thought that passes through the mind, causes some disturbance, produces some change, in the minute particles of the organs through which they pass.[1] Thus, when we bring into action any particular part or organ of the body, we produce a certain change, introduce a certain bias among its particles, so that they become more disposed to act in the same way a second time, and more and more with each repetition.[2] Thus what was at first accomplished

[1] "Every sensory impression, no matter whether discriminated or not, affects the circulation and develops heat. The bloodvessels of the part impressed expand, vessels elsewhere contract; a change in the blood pressure has been effected, which of course implies that the whole organism has been affected. Delicate instruments show that at the time a sensation is produced, the temperature of the brain is raised. The same is true of ideation."—*G. H. Lewes.* "An emotion, besides the obvious changes it works in the muscles of the face, habitually works changes, external and internal, throughout the body at large. The respiration, the circulation, the digestion, as well as the attitudes and movements, are influenced by it even when moderate; and everyone knows how strong passions, pleasurable or painful, profoundly disturb the whole system."—*Herbert Spencer.* "Lavater has observed, and perhaps justly, that there is no muscle or even bone of the human body that does not in some degree or other sympathise in the prevailing passion of the mind, and bear evident marks of having been operated upon by its influence; while as the bones and muscles of the face are nearest the scene of action, and most obvious to the view of the spectator, the predominant disposition may be more easily studied and calculated from these than from any other."—*Dr. M. Good.*

[2] "The aptitude which is acquired by practice for the performance of certain actions that were at first accomplished with difficulty, seem to result as much from a structural change which the continual repetition of them occasions in the muscle, as in the habit which the

with difficulty becomes by degrees more and more easy, till it comes to be almost a second nature, and the difficulty rather is to refrain from doing it when the circumstances are favourable. The practice has grown to a habit, and the parts concerned have grown into correspondence therewith. Thus each organ of the body bears in its substance the marks or traces of how it has been accustomed to act.[1]

When we recall a past sensation or movement, or a thought previously entertained, we employ the same parts and in the same way as they were employed in the original act. When, for instance, I recall an act I have previously done, I am materially assisted in doing so by the state of the muscles, by means of which the act was originally executed; or when I recall an object of sight, I refer, not to the brain alone, but also to the retina on which the object was previously depicted. Memory thus follows exercise, and in pro-

nervous system acquires of exciting the movement."—*Dr. Carpenter.* "After each action it (a muscle) is better prepared for action, more disposed to a repetition of the same work, and readier to reproduce a given organic process."—*Th. Ribot.*

[1] "The tissues and organs of the animal body, when once employed in the exercise of their functions, are subject to continual loss of material, which is restored by nutrition. This waste or consumption of matter with which, so to speak, the use of a part is attended, takes place in different modes and degrees in different structures. . . . The functional action of muscle is attended with an expenditure of moving force, and a portion of matter, derived in part from the muscle itself, is consumed in the production of that force; that is, it undergoes a chemical change, and being by this alteration rendered unfit to serve again, is removed by absorption. The amount of matter changed in a given time, or, in other words, the rapidity of the nutritive process, is much greater in those instances where there is a production and expenditure of force than where the tissue serves merely passive mechanical purposes. Hence the bones, tendons, and ligaments are much less wasted in exhausting diseases than the muscles, or than the fat which is consumed in respiration and generates heat."—*Quain's Anatomy.*

portion as we exercise and train any part do we improve and strengthen the memory of that part. Thus not the brain alone but the whole body is the true seat of memory.

In attempting to illustrate this view further, it is not our intention to enter fully or minutely into the anatomy and physiology of the human body, but rather to touch upon certain points in these sciences that are more immediately connected with our present subject.

The human body is constantly undergoing change. Its growth, its maintenance in health, its very life, all depend upon this.[1] Its several parts are constantly giving off effete particles, and are as constantly taking up fresh materials to supply their place. This is what is constantly going on at all times in the living body; but more especially when a part or organ is in a state of activity. Then the waste that takes place in the part is greater, the particles die off and are carried away more rapidly, and in consequence the assimilation of fresh materials goes on with greater speed.[2] In

[1] "Unless there be movement there is no life, vital or psychical: immobility is death."—*G. H. Lewes.* "The condition of life is death. No part of a living mechanism can act without wearing away, and for the continuance of its functions there is therefore an absolute necessity for repair. . . . The essential condition of life is waste of the body."—*Dr. Draper.* "Life could not be maintained in organs remaining in perfect repose; all is agitation, all is movement in organised bodies."—*Dr. A. M. B. Riofrey.* "The characteristics of the living organism are ceaseless change and ceaseless waste. Directly a man begins to live he begins to die."—*Dr. Tanner.* "Leben ist Nichtsein ist Werden; sein ist der Todt."—*Dr. Erdmann.*

[2] "Our material frame is composed of innumerable atoms, and each separate and individual atom has its birth, life, and death, and then its removal from the place of the living. Thus there is going on a continual process of decay and death among the individual atoms which make up each tissue. . . . These processes are greatly influenced by the activity of the bodily functions. Each operation of the muscles or nerves involves the disintegration and death of

ordinary circumstances the amount of waste that takes place is more than made up by the increased supply of new matter, and in consequence the part gradually grows in size and strength.[1] It also becomes by degrees better adapted for carrying on the same kind of actions, for no doubt the supply is greatest where the greatest waste is taking place, and the new matter being more pliant than the old, is more readily moulded and fashioned in the required direction; for, as is well known, "function develops structure in the direction of its activity".[2]

The blood, that well-known red fluid which circulates

certain part of their substance. We cannot lift a finger, we cannot perform the slightest movement, without causing a change in certain of the atoms which compose the muscles executing the movement, in those of the nerve conveying the stimulus which directed them to contract, and in those composing the nerve centres in which the stimulus originates; and this change involves their decay and death." —*A. Maclaren.* "Tiedemann remarks that an organ in an excited state undergoes more rapid changes in its material composition, and therefore attracts more quickly and in larger quantity the blood, which alone is able to render an organ capable of increased vital action."—*Dr. J. Müller.*

[1] "The frequently-renewed exercise of muscles, by producing a determination of blood towards them, occasions an increase in their nutrition; so that a larger amount of new tissue becomes developed, and the muscles are increased in size and vigour. This is true not only of the whole muscular system when equally exercised, but also of any particular set of muscles which is more used than another."—*Dr. Carpenter.*

[2] "From what general law of the redistribution of matter and motion does it result that when a wave of molecular transformation passes through a nervous structure there is wrought in the structure a modification such that, other things equal, a subsequent like wave passes through this structure with greater facility than its predecessor?"—*H. Spencer.* "Every kind of activity peculiar to a living body involves a change of structure, and the formation of the newly generated tissue receives such an influence from the conditions under which it originates that all its subsequent activity displays their impress."—*Dr. Carpenter.* "The effect of practice shows that the more frequently the same fibres are thrown into action, the easier does their action become."—*Dr. J. Müller.*

through all parts of the system, is the means by which nourishment is conveyed to the different parts, and also the wasted particles that are no longer of any use are carried away.[1] "The life of the body is the blood." It is this which carries everywhere in unceasing currents the vivifying stimulation by means of which all our bodily activities are carried on. So much depends upon it that if, in the brain, its circulation be but momentarily suspended, the whole vital machinery is at once brought to a stop.[2]

The blood may be said to be the different constituents of the several parts of the body—nerve, muscle, bone, &c.—in a fluid state. It is composed of water holding in solution fibrin, albumen, potassium, and sodium, together with phosphoric acid and other substances, and having immersed in it numerous corpuscles or globules of a red or white appearance, the former being much more numerous than the latter, and imparting to it its red colour. The average quantity of blood in an adult man is about 28 lbs. or pints.

There are various organs for diffusing, renewing, and cleansing the blood, each of which requires to be in an efficient condition in order to the blood being in a proper state. The organs of circulation are the heart, arteries, veins, and capillaries; the organs of alimentation, the mouth, gullet, stomach, and intestines, with

[1] "The blood is the agent which not only supplies both food and oxygen, but sweeps away all refuse, and, we may add, is the instrument for maintaining an adequate temperature. All the rest of the body may in fact be looked upon as busied in manufacturing food into blood, in keeping up the oxygen supply of the blood, in sifting out from the blood all waste material, and in maintaining the blood at a uniform heat."—*Dr. M. Foster.*

[2] "If the circulation through the brain be suspended but for an instant, insensibility and loss of voluntary power supervene and continue until it is restored."—*Dr. Carpenter.*

their appendages; and the excretory organs, the skin, lungs, and kidneys.

The heart is the organ by which the blood is propelled to all parts of the system. The arteries receive the blood from the heart and conduct it to the different parts of the body, where it is taken up by minute vessels, the capillaries, which penetrate the different tissues, and through the thin walls of which the materials transude which are necessary for their sustenance. Each several tissue selects from the blood the materials necessary for its support, and the blood thus deprived of its valuable materials, and being, besides, polluted by receiving the worn-out particles of the tissues, passes into the veins, by which it is conveyed back to the heart. The blood in the arteries is of a florid red colour, but when it reaches the veins it has acquired a dark purple hue. From the heart the impure blood is propelled to the lungs, where it is subjected to the action of the air, and so purified, giving off carbonic acid and imbibing oxygen. The purified blood is then returned to the heart, by which it is again propelled to all parts of the system. The oxygen in the blood stimulates the action of the tissues, and seizes upon and burns up the effete particles, thus giving rise to an amount of heat which is sufficient to maintain the temperature of the blood at about 100°.[1]

Seeing, then, the important part played by the blood in the animal economy, it will naturally be expected to have an important influence upon the memory. This

[1] "By the action of oxygen every tissue is being differentiated, and every tissue is integrating the materials supplied by the blood. No function can be performed without the differentiation of the tissue performing it, and no tissue is enabled to perform its functions save by the integration of nutriment."—*H. Spencer.*

we find to be the case;[1] for when the quantity or quality of the blood is impaired, when the body is feeble or exhausted, the power of memory is at a low ebb. "In a general way," says M. Ribot, "reproduction of impressions seems to depend upon the circulation. . . . Exaltation of the memory ensues when the circulation is increased by stimulants, such as hachish, opium, &c. . . . Other therapeutic agents induce a contrary effect." "Feelings excited when the general circulation is very vigorous are more revivable than usual. . . . Fatigue in any form is fatal to memory; the received impressions are not fixed; reproduction is slow, often impossible."—*Herbert Spencer.* "I have often," says Sir Henry Holland, "known the power thus transiently failing from fatigue or debility of disease restored by the stimulus of a moderate quantity of wine, and so suddenly as to show that the want of due excitement to the circulation was the cause of the failure." He further mentions that once when visiting some deep mines in the Hartz mountains, he became so exhausted by fatigue that every German word and phrase deserted his memory, so that he was no longer able to converse with the German inspector who accompanied him, till he had taken some food and wine, and had some rest, when they returned to him.

It is probably mainly owing to a temporarily weakened state of the circulation or an impaired condition of the blood that we fail to remember at one time what we can readily recall at another. Sometimes in trying to remember a thing, the very thing itself may come

[1] "The receptivity of impressions is high during those portions of life in which the blood is propelled in full and rapid currents."—*H. Spencer.* "A normal exercise of the memory supposes an active circulation and blood rich in the materials necessary for integration and disintegration."—*Th. Ribot.*

into the mind, and we may fail to recognise it as that we are in search of, while afterwards, when we again recall it, we at once perceive it to be what we sought.

It would also seem that in those remarkable cases where the memory is, through disease or accident, partially lost and afterwards suddenly restored, the cause is to be attributed to the circulation. Thus a gentleman on recovering from a fever finds that he has entirely forgotten a language with which he was previously familiar. He commences the study of it again, and has made some progress in the rudiments, when suddenly, while endeavouring to construe a difficult passage, "he," we are told, "is conscious of a physical change taking place in his brain," and all at once the whole of his forgotten knowledge comes back to him. It would seem that from some cause or other the necessary supply of blood to the part of the brain directly concerned had been withheld, and is then suddenly restored; "for," says Dr. Carpenter, "it is generally found that such restoration takes place under emotional excitement, which has a peculiar power over the vaso-motor system of nerves regulating the calibre of the arteries".[1]

When we come to consider the effects of the circulation on the two parts of memory—retention and reproduction—we think we discern a marked difference between them.[2] An increased circulation seems to act

[1] "Some physiologists have advanced the theory that limited and temporary lapses of the memory are due to local and transient modifications in the calibre of the arteries under the influence of the vaso-motor nerves. The reason for this view is that the return of mental power is sudden, and is ordinarily induced by strong emotion, and that the emotions exercise a particular sway over the vaso-motor system."—*Th. Ribot.*

[2] "Memory consists of a conservation and a reproduction. Conservation seems to depend especially upon nutrition; reproduction upon general or local circulation."—*Th. Ribot.*

more particularly upon the reproductive faculty,—past ideas and sensations being then brought up before consciousness with the greatest rapidity and clearness.[1] Hence, under the stimulating effects of wine or opium, and the like, ideas spring up in the mind with the greatest profusion. But the effect is by no means so marked in the retentive faculty, for the rapidity of the circulation seems to interfere with the fixing process, and hence it is that we usually remember less of what occurred on such occasions than at ordinary times.[2] It is rather the slow, full pulse that is most favourable to retention.

Thus memory is largely dependent upon the condition of the blood, and that upon the general health of the body, and hence those times should be chosen for the exercise of the memory when the physical powers are strongest, and the blood in consequence in its best state.[3]

The great bulk of the body is made up of motor organs designed for the carrying out of the purposes

[1] "In a general way reproduction of impressions seems to depend upon the circulation. . . . We may note the ease and rapidity with which reproduction takes place at that period of life when the blood is driven through the veins in plentiful and swift-moving streams, and how slow and difficult it becomes when the circulation diminishes with advancing years."—*Th. Ribot.*

[2] "A drunkard either forgets altogether or has only a vague recollection of the nonsense which he talked and the follies of which he was guilty on the previous day while under the influence of alcohol." —*Sir B. Brodie.* "Mr. Combe mentions the case of an Irish porter to a warehouse who, in one of his drunken fits, left a parcel at the wrong house, and when sober could not recollect what he had done with it; but the next time he got drunk he recollected where he had left it, and went and recovered it."—*Dr. M'Nish.*

[3] "It is not enough that impressions be received; they must be fixed, organically registered, conserved; they must produce permanent modifications in the brain. . . . This result can depend only on nutrition."—*Th. Ribot.*

nd intentions of the mind. It is by means of the odily organs that the mind reveals itself, and makes nown to others what is passing within itself,—it may be y speech, by pen, or by gesture.[1] The loftiest thoughts, ie highest conceptions of the human mind, would emain unknown and useless unless they thus found xpression. The genius of a Shakespeare or a Milton ould have existed in vain had they not had the power f conveying to others what existed in their own minds.[2] ndeed, it may well be doubted whether, without the ower of expressing our thoughts, even thought itself ould have any existence, or could have any hold on ie memory.[3]

The bones, joints, and muscles are admirably fitted r the performance of a vast variety of movements; nd a minute and intricate system of nerves connects ie different parts with the brain, thus bringing them irectly and readily under the control of the mind. Ian greatly excels all other animals in the extent and ariety of his movements, and to this cause, doubtless, is mental superiority is in no small degree owing.[4]

[1] "The greater part of the animal body is a collection of muscular ores; some serving for locomotion, others for special manœuvres of rticular members and parts, others as an assistance to the senses, id yet others for the production of voice, and in man of speech."—*r. M. Foster.*

[2] "Without the concurrence of the muscular power man's grandest nceptions and most energetic resolutions would remain equally iknown and unfulfilled. . . . Mind is no doubt the high and recting power; but without obedient muscles, ready at a call to inister to its wants, mind would remain isolated in the midst of eation, and could neither speak, nor hear, nor touch."—*Dr. A. mbe.*

[3] "Language is indispensable not merely to the communication it to the formation of thought, since it favours the birth of concepts general notions, and is essential both for their preservation and miliar use."—*Dr. Bastian.*

[4] "The superiority of the human over the animal mind seems to

The bones not only afford support and protection t the soft parts of the body, but furnish levers and point of insertion for the muscles, and also form the joint They are commonly reckoned at 206 in the adult, an are so numerous, doubtless, in order to admit of grea variety of movement. The surfaces of the bones ar hard and compact, with here and there small opening or pores leading into the interior, which becom gradually more and more spongy and open, till finall merging, in the long bones, into the great central cavit in which the marrow is lodged. These pores or open ings serve to admit of bloodvessels and nerves passin into the structure of the bone. Bones are largel supplied with bloodvessels, and a constant process c waste and renewal is carried on in them, as in othe parts of the body. Hence they require to be supplie with nutritive material in order to their maintenanc in a healthy condition. Though furnished with nerve bones possess little sensibility in a state of health, bu they become highly sensitive in certain forms of diseas They are covered with a peculiar membrane called th *periosteum*, which serves to lodge and conduct the bloo vessels and nerves, and also plays an important part i the partial reproduction of bone when injured.

The bones increase in size and strength in proportio as the muscles in connection with them increase i power and are called into frequent action. Hence, ne to an adequate supply of proper nourishment, a du amount of muscular exercise is necessary in order t

be essentially connected with the greater variety of muscular acti of which man is capable."—*Dr. Maudsley.* Motion "is the gre characteristic of animal life, and the contrast between the lowest a the highest animals is in nothing more marked than in the sm self-mobility of the one and the great self-mobility of the other".- *H. Spencer.*

ıeir maintenance in a healthy condition. Without ıis they lose their strength and firmness, diminish in ze, and become crooked and deformed. If the muscles e paralysed the bones waste, and no amount of passive otion will prevent or retard the atrophy. Thus ıysical exercise not only develops and strengthens the uscles, but it has a similar effect upon the bones, and ence the necessity of it to all, particularly the young. ithout this the growth is stunted, the health impaired, ıd the limbs weak, crooked, or deformed. Further, hatever weakens or injuriously affects other parts of e system acts similarly upon the bones, as living in owded habitations, deficiency of air or light, unwhole- me food, impaired digestion, &c. The bones adapt emselves to the softer parts, and not the softer parts them. Thus the skull enlarges in proportion as e contained brain becomes larger; and the muscles ıpress themselves upon, and fashion the adjacent nes.[1]

Seeing that the bones are well supplied with nerves, at there is constant change going on in them, and at they are improved and strengthened by exercise, is not too much to say that they must possess a kind memory in conjunction with the muscles, in concert th which they act.

The joints are of different kinds, to meet the required ms of movement, and are all fashioned on the most entific principles. The ends of the bones, which are

[1] "Just as in their natural development and growth, the bones of skull are formed in adaptation to the brain . . . so in disease y submit in their nutrition to adapt themselves to their more ive parts. Thus the skull enlarges when its contents do; and bones of the limbs strengthen themselves as the muscles inserted them become stronger and more active; and they do this in ptation to the force of the muscles, and not merely because of movements they are subject to."—*Sir James Paget.*

brought into contact, are covered with cartilage in orde to admit of easy, smooth, and gliding motion upon on another; and the several parts are kept in their place by means of ligaments of great strength and tenacity.

The muscles are the means by which the differen movements of the body are performed. They consti tute the flesh of the body, and are arranged in layer over it in such a way as to give beauty and symmetr to its form, as well as being admirably adapted for th purposes of motion. They are of various forms an sizes, being on the trunk generally broad and flat, an on the limbs narrow and elongated. For the most par they are attached by both their extremities to th bones, either directly or indirectly, by means of whit flexible but inelastic cords, called tendons. The mostly consist of a middle fleshy portion named th belly, by means of which the movements are carrie on, and two ends, which serve for attachment to th bones. The muscles are for the most part arranged i pairs, acting antagonistic to each other, as flexors an extensors, abductors and adductors, supinators an pronators; and are distinguished by names suggeste by their form, position, function, &c. There ar reckoned upwards of 500 distinct muscles in the huma body, and yet with all this complicated machinery every thing is in order, everything in harmony.

The peculiar property of muscular tissue is its con tractility, or the power it possesses of contracting it substance on the application of stimuli, and of relaxin when these are withdrawn.[1] Contraction is effected b

[1] "It is in virtue of the contractility possessed by the muscl that all the sensible movements of the higher animals are performe the skeleton framework . . . furnishing a system of levers by whi the contractile power of the muscles may be advantageously applie —*Dr. Carpenter.*

simultaneous shortening of the fibres of which the scle is composed through the approximation of their stituent particles, so that it becomes shorter, thicker, l harder, and diminishes slightly in volume. The perty of contractility appears to be inherent in the scle, and not to be derived from the nervous system, it may be manifested by muscle after being isolated m nervous influence. The contracted state of the scle is regarded as the active one. The muscles are stantly in some degree of contraction, as is evident m the fact that when the action of certain muscles impaired, the antagonistic ones always draw the t towards them, as, for example, when the muscles one lateral half of the face are paralysed, those of the er half draw the features towards that side.

Muscles are distinguished as voluntary and involun- y,—according as they act under the control of the l, or independently of it. The voluntary muscles are se which are employed in the movements of animal , the involuntary those which are concerned in carry- on the internal operations of the system. The two sses of muscles, when examined microscopically, are nd to differ in structure as well as in function. th are composed of fibres, but the fibres of the volun- y muscles are striped, while those of the involuntary plain. The heart, however, is an exception to this ng, though an involuntary muscle, composed of ped fibres.

The fibres of the voluntary muscles averaged about th part of an inch in width, and are beautifully ped or marked with dark lines passing transversely oss them, while others of a lighter colour extend gthwise. Each fibre has an enveloping sheath or *colemma* of extreme tenuity, and the contained matter

may be split up longitudinally into a number of minut fibrils or transversely into discs corresponding with th dark lines by which it is marked. Thus, the fibrils an the discs consist of the same parts—*i.e.*, of small cubic particles, only, in the one case, they are attached length wise, and in the other lie side by side. Each fibre estimated to contain 600 or 700 fibrils.

The fibres are collected into small *fasciculi*, or bundle which again form larger ones, and these others sti larger, until, in the largest muscles, there may be thou sands and even hundreds of thousands of them. Th fibres run parallel with each other in the fasciculi, an the fasciculi extend (with few exceptions) continuousl from one terminal tendon to the other. The fibre however, are of limited length,—not usually exceedin one and a half inch; and, accordingly, in a long fasc culus, a fibre does not reach from one tendonous attac ment to the other, but ends in a tapering pointed extr mity invested with its sarcolemma, and cohering wit neighbouring fibres. Each muscle is enveloped in covering of areolar tissue, by which it is at the sam time connected with and isolated from the neighbou ing parts, and which also passes inward, similarly e sheathing the smaller bundles of fibres of which eac is composed, and affording support to the bloodvesse and nerves. The number of voluntary muscles which distinct names have been given amounts to abo 240, of which 75 are in the head and neck, 51 in th vertebral column and trunk, 58 in the upper limb, ar 59 in the lower limb.

The fibres of the involuntary muscles are pale, so smooth, roundish, or slightly flattened, and general from $\frac{1}{2700}$th to $\frac{1}{3100}$th of an inch in diameter. Th are collected into fasciculi, which form the muscle

ıese constitute the proper contractile coats of the ɔmach, intestines, bladder, arteries, &c.

Muscular tissue is abundantly supplied with blood-ssels and nerves. "The arteries, accompanied by eir associate veins, enter the muscle at various points d divide into branches; these pass among the fasci-li, crossing over them, and dividing more and more they get between the finer divisions of the muscle; length, penetrating the smallest fasciculi, they end capillary vessels which run between the fibres." ıese "form among the fibres a fine network with ırrow oblong meshes, which are stretched out in the rection of the fibres".—*Quain's Anatomy.* None of the pillaries enter the sarcolemma of the fibre, and hence e nutritious fluid which they convey must be taken by imbibition.

The nerves, like the bloodvessels, enter the substance the muscles, and pass between the different bundles fibres down to the smallest. In their course they equently divide and subdivide, and form numerous exuses, the branches growing finer and the meshes ɔser as they advance into the tissues—single fibres of rves finally passing off to the individual muscular ɔres. The mode of termination of the nerves in the uscles is by no means certain.[1] According to some ey do not penetrate the sarcolemma, but ramify er it in branches of extreme tenuity. Others main-n that they end in nerve-plates or discs, which are scribed as "small lamelliform objects of an oval or egular, and often deeply indented, outline," and as

[1] "The controversy respecting the manner in which nerves end in scles seems likely to terminate in the conclusion that they do not l at all, but pass, by continuity of substance, into the sarcous ments."—*Dr. Maudsley.*

varying in size from $\frac{1}{1500}$th to $\frac{1}{350}$th of an inch diameter, according to the size of the muscular fibre, whose circumference the plate may embrace one-thi or more. Some believe that these plates are situat on the outside, others within, the sarcolemma.[1]

The nerves serve to convey from the nerve centres the muscles the stimulus by which they are set in m tion, and also to carry back to the centres informatic respecting the state or condition of the muscles. Tl nerves connected with the muscles are principally mot nerves, and there is reason to believe that the sensibilit accompanying muscular movement is owing to then and not, as in other parts of the body, to sensory nerve —(See Chapter IV.)

The amount of common sensibility residing in muscle is not great at least in its healthy state, f it may be cut or pricked without giving rise to seve pain. But it possesses in a high degree a peculiar se sibility to its own states and conditions when in actio so that the mind is able to determine with accuracy th amount of effort that is necessary to be put forth o any given occasion. It is by means of this sensibilit which not only reveals the present but recalls past mu cular states, that every exertion is directed and appo tioned in intensity to the effort required to be made and the degree of perfection to which this sensibilit may be brought by training and habit is seen in tho who execute minute and delicate pieces of workma ship, or excel in certain games. Thus, the skilf billiard player exhibits a wonderful nicety of muscul

[1] "These bodies are external to the sarcolemma, though adheri intimately to it. . . . It appears probable that they are a reduplic tion and expansion of continuous fibres rather than terminal orga formed upon the extremities of the nerve-fibres."—*Dr. Beale.*

scrimination and adjustment in directing his balls; ıd the expert batsman in cricket has, the instant he es the direction of the ball, to decide upon the best ay of meeting it, and to bring the proper muscles into ay.[1] We are told that in steel-pen making "a quick nale worker will cut out in one day of ten working urs 250 gross, or 36,000 pens, which involve 72,000 stinct movements of the arm, two in every second". ırther, it is found that some persons can pronounce stinctly as many as 1500 letters in a minute, each of ıich must involve a separate contraction and relaxa-on of muscular fibres, both occupying $\frac{1}{25}$th, or each th of a second. In no other direction do we find the 'ects of training more manifest than in the muscles; d the rapidity of movement or power of sustained tion of which they are capable, if properly trained, is ırcely conceivable.[2]

In order to a healthy condition of muscle, a due pply of arterial blood is necessary.[3] When the blood insufficient in quantity or deficient in oxygen, or arged with carbonic acid, the contractile power of the ıscle is largely diminished, or it may be entirely lost. ıe next requisite is that it receive a certain amount

1 "The batsman, perhaps, furnishes us with the most striking tance of the rapidity of thought: he sees the ball coming, he has ıppreciate its speed and its direction, and he has to determine in a ment whether to strike or block, and if the former, in what direc-ı he should swing his bat."—*Anon.*

2 "These qualities may be particularly observed in the execution nany species of instrumental music, in which the changes pro-ed by the hand of the musician are exceedingly rapid; are exactly ısured even when most minute; and display on the part of the scles an obedience of action alike wonderful for its quickness and correctness."—*Dr. Paley.*

3 "There can be no question that the condition most essential to maintenance of muscular contractility is an adequate supply of rial blood."—*Dr. Carpenter.*

of exercise. If a muscle is allowed to remain for an length of time in a state of inaction, its substance gradually wasted, and its powers are proportional weakened,—it may be, eventually lost. A state continued contraction is so unnatural that it cann be maintained for any length of time, the muscul powers being speedily exhausted without any mea of restoration. Hence the evils that result to childre from too long confinement in one position.

It is by means of exercise that we improve an strengthen the muscles, and memory follows exercis The muscles that are most exercised most readi retain and recall the impressions they have receive The seat of the memory of these impressions, in ou view, is not the brain or nerves; but the muscles then selves, by which the actions were effected. What th muscles receive from the nerves is simply the stimulu by which they are set in motion. The power of accu rately regulating and directing the amount of force t be put forth in any action depends on the muscle themselves, and is derived from the stored-up memo of past impressions. A very feeble nervous stimulu may produce a great muscular effort.[1]

[1] "The amount of work which a muscle does in lifting a weig does not depend on the amount of stimulus which you apply to t nerve. You set the nerve in action, and it conveys some kind stimulus to the muscle, which has the result of liberating the ener stored up in the latter. The muscle may be regarded really as co taining energy in a potential condition, and the action of the ner is not merely to force the muscle to contract, but, as it were, set free this energy in the muscle. . . . A very feeble prima irritation is sufficient to produce a great effect. The muscles conta energy stored up in themselves, and the nerve may be regarded the liberator of the energy."—*Prof. M'Kendrick.* It seems "th irritability is a property inherent in muscular tissue, and that t agency of the nervous system upon it is merely to call it into act operation".—*Dr. Carpenter.* "It would be a mistake to suppose t they (the nerves) supply the force needed to contract the muscl

There can be no doubt that the mind or will has naturally by no means that control over our movements that is commonly supposed, and that the nature and character of our actions depend more upon the state and condition of our muscular system, and the way in which it has been accustomed to act, than is generally believed.[1] Habits and practices that have been long indulged in may set at defiance any power of the will that can be brought against them.[2] Hence the will or desire to accomplish a particular purpose, or to carry

hat we have seen the muscle can supply for itself; they only send he stimulus for its co-ordinated production. . . . It is generally hought that the spasmodic actions induced by brucia, strychnia, pium, &c., are due to the direct influence of the poison upon the erve-tissue. This may be so, yet, perhaps, the muscular system hares more in these phenomena than is generally recognised."—*Dr. Laycock.*

[1] "The whole process by which we acquire the power of adapting ur muscular actions to the performance of some new kind of novement . . . is found, when attentively studied, to indicate that he will is far from having that direct and immediate control over he contractions of the muscles which it is commonly reputed to possess. . . . However amenable any set of muscles (as those of the rm and hand) may have become to the direction of the will in ny operations which they have been previously accustomed to perform, it is only after considerable practice that they can be trained o any method of combined action which is entirely new to them."—*Dr. Carpenter.*

[2] "There is a wrong philosophy in supposing that a habit which as fixed itself in the fleshy nature can be overcome by the mere xertion of the will. It is not enough to resolve against it. You annot vanquish it by the power of a resolution. To that must be dded continuous training."—*H. W. Beecher.* "Whatever a man nay inwardly think and (with perfect sincerity) say, you cannot ully depend upon his conduct till you know how he has been accusomed to act. For continued action is like a continued stream of vater, which wears for itself a channel that it will not be easily urned from."—*Archbp. Whately.* "I see," says the Apostle Paul, 'another law in my members warring against the law of my mind," nd "the good that I would I do not; but the evil that I would not, hat I do. . . . To will is present with me, but how to perform hat which is good I know not."

out a certain course of conduct, is not enough; the individual must further be taught how it is to be done and the muscles trained to the proper movements. If we wish a boy to act in a particular way, we must not only instruct his mind and give him the desire so to act but we must also implant in him the power and habit of acting as we wish.[1] We must take care to have the muscular memory on our side, and not against us How frequently are children scolded or punished for faults,—outbursts of passion, or acts of apparent obstinacy, that are no more under the power of their will than are the motions of the paralytic. Even the will itself requires to be trained in order to understand how to rule and control its subordinates. No one expects from a child the physical strength and endurance of a man, but few consider that it is equally absurd to expect the same strength of mind, or power of will, or sense of right and wrong. In the one case as in the other, time and patient and careful exercise are necessary,—beginning with what is simplest and easiest and rising by degrees to the more difficult, and more arduous.

In order to train any particular set of muscles, we must exercise them. We cannot improve or strengthen any set of muscles by the exercise of other than themselves. So with memory. We strengthen and improve the memory of any set of muscles by the exercise of them, and cannot do it in any other way.

[1] "The acquirement of voluntary power over the movements of the limbs is just as gradual as it is over the direction of the thought —all the activity of the body, as well as of the mind, being, in the first instance, automatic, and the will progressively extending its dominion over the former as over the latter, until it brings under its control all those muscular movements which are not immediately required for the conservation of the body, and turns them to its own uses."—*Dr. Carpenter.*

Our physical actions have an important bearing upon our mental states. Our thoughts spring from our actions, and there is every reason to believe that without action, without the power of giving expression to our thoughts, we could not think.[1] In the new-born babe action precedes both thought and feeling; for the child does not feel, or think, or will, before the performance of movement, but the feeling, thinking, willing, result from such performance.[2] It is well known, too, that certain movements or attitudes of the body give rise to corresponding thoughts or feelings in the mind;[3] and is it not frequently the case that men act first and think afterwards,—that the thought does not lead to the action, but the action give rise to the thought? This seems to be borne out by what we observe in the course of human progress, where we find the art usually preceding the science, and men practising the arts of poetry, rhetoric, logic, painting, &c., before they knew or thought of the rules applicable to these subjects.

The importance of action or expression to thought is further seen in the case of persons of weak mind or little culture, some of whom will be observed to require to repeat a question or a sentence to themselves before

[1] "The expression or embodiment of the feeling . . . is not only the means of making known the state to others, but also an essential concomitant of its own existence."—*Prof. Bain.*

[2] "Movement precedes sensation, and is at the outset independent of any stimulus from without."—*Prof. Bain.*

[3] "When we fix the countenance in the expression, or the body in the attitude which any passion naturally occasions, it is most certain that we acquire, in some degree, that passion. . . . The special muscular action is not merely the exponent of the passion, but truly an essential part of it."—*Dr. H. Maudsley.* "The expression or embodiment of the feeling . . . is not only the means of making known the state to others, but also an essential concomitant of its own existence. . . . I look upon the expression so called as part and parcel of the feeling."—*Prof. Bain.*

they can comprehend it. "Such an one," says Dr. Maudsley, "often cannot content himself with the mental representation of a word, or clearly comprehend a question put to him without bringing the actual movements to his assistance,—he must utter the word or repeat the question aloud in order to get his conception distinctly." Thus, when the mind is weak and defective, it seems to require the aid of the corresponding muscular movements in order to have clear conceptions.

By giving expression to a thought we give it clearness, definiteness, and point; by putting our beliefs into practice we test and sift them. Our actions, likewise, serve the important purpose of regulating and controlling our thoughts, and checking unprofitable and dreamy flights of the fancy.[1] The man whose physical powers are but little called into exercise is thus in a measure cut off from the sober realities of life, and is apt to entertain very extravagant notions of things. From dwelling too much in the region of thought, he becomes a day dreamer or an enthusiast; and, losing sight of the distinction between thought and action, the two become in his mind almost identical, and he fancies that to act is scarcely, if at all, more difficult than to think,—that a thing may be done almost as easily as thought about. This is borne out by what is observed in the case of those who have lost the muscular sense or sense of motion, as in the general paralytic,—such an one having engendered in his mind the most extravagant notions of what he can do.[2] By recognising the part

[1] "The perfect function of the muscular sense is not only of essential importance to the expression of our active life, but, like the function of any one of the special senses, it has its due part in our mental life."—*Dr. Maudsley.*

[2] "As the sleeper, whose external senses are so closed as to shu

which the body, and particularly the muscular system, plays in our actions and conduct, and even in our thoughts, we come to know the source of many of our defects and shortcomings, and to understand how to deal with them.

The nervous system is the highest and most perfectly organised portion of our physical nature. All the other parts of the body exist to serve and minister to this as chief, and from it they derive their vitality and power of acting. It is especially in the superiority of his nervous organisation, and more particularly of his brain, that man physically excels all the lower animals.

The nervous system is the means through which the mind acts upon the body, and the body upon the mind. The impressions that are made upon the organs of sense are taken up by the nerves, and conducted to the great central nervous organ, the brain; and from this organ, by means of nerves, the influences are transmitted which set in motion and direct all our physical activities. In the central nervous organ we have the

out the controlling influence of external objects, often does in his dreams the most wonderful things, and finds little or no hindrance to an almost miraculous activity, intellectual or bodily, so the general paralytic, whose defective muscular feeling cuts him off from the due appreciation of external relations, has engendered in his mind the most extravagant notions as to his personal power; he dreams with his eyes open. . . . A tailor who is suffering from general paralysis will readily promise to make a magnificent waistcoat, and if the materials are supplied to him will at once set to work. It is not improbable that, deceived by his quiet assurance, and knowing that to sew is his business, one may believe he can make the waistcoat. But in a little while it will be found that his stitches are most unequal in size, and are placed in the most disorderly way; and it is made clear that, whatever he himself may think, he certainly cannot sew. He has a sufficient desire to accomplish the result, an adequate general notion of the end desired, a full belief in his ability to effect it, but he fails because his muscular feeling is very deficient, and because he cannot regulate the action of the necessary muscles."
—*Dr. H. Maudsley.*

principal, if not the sole, physical seat of all that is embraced under the term mind,—sensation, thought, volition. Further, the nerves serve to connect together the different parts or organs of the body, and to unite them into one complete whole under the great central organ by which they are all animated and controlled. The body being made up of a number of different parts, all dependent upon each other, it is necessary that they be connected together, and be under the direction and control of some central authority, in order to their working together in harmony.[1]

In the nervous system we have two distinct kinds of organs, differently constituted, and performing different functions,—the nerves and the nervous centres. The nerves serve to connect the different parts of the body with the centres, thus forming the means for the transmission of influences from the one to the other; while the centres generate nerve force, and also enable the different nerves and nerve fibres to communicate with each other, and to act in harmony. The great central mass of the nervous system is named the *cerebro-spinal centre* or *cerebro-spinal axis*, and comprises the brain and spinal cord. The nerves connected with it proceed principally to the muscles, the organs of the senses, and the skin.

Besides this, there are situated in different parts of the body, and connected with nerves, numerous bodies named ganglia, which, though much smaller in size and less complex in structure than the brain, agree with that organ in their general formation, and in their rela-

[1] By means of the nervous system "we are brought into those relations with the external world which give rise to sensation. It also regulates and co-ordinates all the processes of life. It gives unity to the wondrous multiplicity of organs and their actions, making each depend on each, and all co-operate to one end."—*G. H. Lewes.*

tion to the nerve fibres, and doubtless also, in some measure, in regard to the functions which they perform, or the uses they serve in the animal economy. They constitute, indeed, so many nervous centres to which impressions are conveyed, and from which stimuli are emitted, but they act without consciousness and without the intervention of the will.[1] A chain of ganglia, connected by nerve cords, runs along each side of the spinal column, from the cranium to the pelvis, and from this nerves with ganglia proceed to the viscera contained in the thoracic and abdominal cavities and the bloodvessels, by means of which their movements are carried on. These constitute the ganglionic or sympathetic system. The nerves of the sympathetic differ from those of the cerebro-spinal system, in being generally of a greyish or reddish colour, and in having numerous ganglia in connection with them. The two systems are connected together by certain branches of nerves which pass from the one to the other, so that most of the nerves of one system contain also fibres belonging to the other. Hence we may have feelings of pain or discomfort in organs connected with the sympathetic system, when these are in a state of disease or

[1] "It seems reasonable to conclude . . . that the ganglia are nervous centres which may probably receive, through afferent fibres, impressions of which we are unconscious, and reflect these impressional stimuli upon efferent or motor fibres; that perhaps even certain motorial stimuli emanate from them,—the movements excited by, or through, the ganglia being always involuntary, and affecting chiefly the muscular parts of the viscera, the sanguiferous and, perhaps, the absorbent vessels; and that, in fine, the chief purpose served in the animal economy by the ganglia and the ganglionic nerve fibres, whether existing in acknowledged branches of the sympathetic or contained in other nerves, is to govern the involuntary and, for the most part, imperceptible movements of nutrition, in so far at least as these movements are not dependent on the brain and spinal cord."—*Quain's Anatomy.*

suffering from injury; and in like manner mental excitement may cause itself to be felt, and produce disturbance in these organs.

The several organs which constitute the nervous system are composed of two distinct substances differing from each other in colour, structure, and chemical composition. The one, characterised by its dark, reddish grey colour, and hence called the "grey" or "cineritious" substance, is vesicular in structure and of a soft consistence; the other is white and fibrous and known as the "white" or "medullary" substance. The former is usually found collected in masses intermingled with the fibrous substance in the nervous centres,—the brain, spinal cord, and ganglia; the latter besides entering largely into the composition of the nervous centres, constitutes the substance of the nerves. The difference in structure of the two substances naturally leads to the conclusion that they perform different functions, and the generally received opinion is that the grey matter serves to generate or evolve nerve force, while the white matter, whether in the centres or in the nerves, acts merely as a conductor of impressions.

The grey substance, when examined microscopically is found to be composed of minute cells or corpuscles commonly called "nerve corpuscles," mingled with a greater or less number of nerve fibres, and imbedded in more or less of a dimly shaded granular substance which gives to it its peculiarly grey or reddish grey appearance. The nerve cells occupy a considerable place in the brain and spinal cord, and principally compose the ganglia. They are always found in connection with nerve fibres, which either spring from or terminate in them.

Each cell is composed of an exceedingly delicate membranous wall, enclosing a soft, finely granular, reddish brown substance, and containing also, attached to some part of its interior, a clear round nucleus, within which is a minute but particularly clear and brilliant nucleolus.[1] Each also sends out two or more processes or poles, composed of the same material as its own body, and serving to connect it with the fibres of the nerves. The nerve cells vary considerably in size, and differ greatly in form, but two principal kinds are usually distinguished,—the angular or caudate, which are larger than the other, and occur principally in the brain and spinal cord, and the spherical, ovoidal, or pyriform, which are most numerous in the ganglia. The former send out from their surface several processes, which, as a rule, divide and subdivide as they pass away from the body, till they attain extreme minuteness, when they appear to form networks with other cell processes, and afterwards to unite with them in constituting nerve fibres. One at least, however, of the processes of a multipolar cell does not branch, but becomes directly continuous with a nerve fibre, and is called the "axis-cylinder process". Recent physiological investigations seem to show that a greater similarity in structure exists between the axis-cylinder

[1] "Photo-chemical histology shows us that the protoplasm of the cell formerly described as a homogeneous substance is arranged in a fibrillary trellis-work; that its nucleus presents an arrangement of radiated fibres; and that what was thought to be the nucleolus is itself a complex element. The nerve cell thus becomes in its turn a little nervous organ *sui generis*. The same analytic processes enable us moreover to demonstrate that the network, so dense and compact, which unites all the nerve cells of the cerebral cortex, for instance, one with another, is so delicate that, when enlarged to 286 diameters, the fibres of which it is composed become visible like single hairs in appearance and magnitude, &c."—*J. Luys.*

of the nerve and the nerve cell than was formerly supposed.[1]

The pyriform or pear-shaped cells have two processes proceeding from the small end of each cell,—one straight and of some thickness, resembling a stalk; the other smaller, rising at some distance from the former twisting several times spirally round it, and then going off in an apparently opposite direction. The straight process rises in the interior of the cell-substance, and some believe that they have traced it into the nucleus while the spiral process appears to have a more superficial origin. The nerve cells are generally regarded as being the seat of nervous energy. They also serve as a means of joining together different fibres, and thus establish a vast system of connections necessary to the co-ordinating of movements and the concatenating of sensations. Dr. Beale is of opinion that the two kinds of cells differ in function as well as in structure, and thinks it probable that the caudate cells serve only to connect together different fibres, and to distribute nerve force, while the pyriform cells simply generate force.

The nerves have the form of cords, and proceed from the cerebro-spinal or other centre to the parts of the body with which they are in connection,—each nerve being composed of a number of nerve fibres enclosed in

[1] "The central extremities of the nerve fibres lie in relation to, and are often directly continuous with, the nerve cells. . . . In the bipolar cells the axial cylinder of the fibre is continuous with the cell-substance, and Schultze has shown that both exhibit a delicate fibrillated structure. The medullary sheath and the primitive membrane are also usually continued from the fibre over the nerve cell. Hence these bipolar cells seem to be, as Schultze expressed it, nucleated enlargements of the axial cylinder. . . . Schultze has pointed out that not only the protoplasm substance of the body of a multipolar nerve cell, but both the non-branched and branched processes possess a fibrillated structure similar to that described by him in the axial cylinder of the nerve fibres."—*Prof. Turner.*

ıe sheath. The fibres are distinguished as "afferent" ıd "efferent," the former serving to conduct im- :essions from the different parts or organs of the body ith which they are in connection to the centres, being so termed "centripetal,"—while the latter convey imuli from the centres to the several organs, and are so called "centrifugal".[1] We are of opinion, how- 'er, that the function of each class of nerves is not ›nfined to conveying impressions only in one direc- ›n, but that afferent nerves, while primarily con- ying impressions from the organs of sense to the ain, have also the power of transmitting impulses ›m the brain to the organs of sense; and in like anner efferent nerves, while primarily serving to nvey impressions from the brain to the muscles, ve also the power of carrying impulses from the uscles to the brain. This will be explained more lly in the next chapter. Usually both sets of fibres e bound up together in one sheath, but the one set fibres never directly communicates with the other,— ch carries its own independent stimulus through its tire length. Fibres can only communicate with ıer fibres, and the stimulus conveyed by one be ınsmitted to others by means of the nerve cells in e centres with which they are connected.

Nerves very often divide into branches, and the anches of different nerves not unfrequently come gether and form *plexuses* or networks, in which they

[1] "The fibres of nerves are endowed with the property of trans- :ting impressions, or rather impulses the effect of impressions, n the points stimulated towards their central or their peripheral remities. Certain fibres are employed to conduct towards the vous centres, and are named 'afferent,' others to conduct towards ir distal extremities, which are distributed in moving parts, and se fibres are named 'efferent'."—*Quain's Anatomy.*

exchange fibres with each other, but the fibres themselves never unite or coalesce. A nerve on leaving a plexus may thus contain fibres from all the nerves entering it. In this way a wider distribution is given to fibres of the same nerves, and thus different parts are able to be brought into combined action.

The cerebro-spinal nerves are all connected with the brain or spinal cord by one extremity which is termed the origin or root. In some cases the root is single, or rises from one spot, in others there are two or more roots. Sometimes the roots differ from each other not only in origin but also in character or function,—the one, it may be, containing only motor, the other only sensory, fibres, as in the spinal nerves,—in which, though the two kinds of nerves are separated at their roots, they are mixed and bound up together in the same sheath in their trunks and branches.

The fibres of a nerve, on quitting the surface of the brain or cord, are, in most cases, collected into *funiculi* which are each invested in a sheath of *neurilemma;* and on escaping from the skull or spine, each nerve acquires its external stout fibrous sheath, which unites all its funiculi into a firm cord. If a nerve be very small it may consist only of one funiculus, but in the larger nerves several funiculi are united together into one or more bundles, which, being wrapped up in a common membranous covering, constitute the nerve. The funiculi do not run along the nerve as parallel insulated cords, but join together obliquely at short distances as they proceed in their course,—the cords resulting from such union dividing in their further progress to form junctions again with their collateral cords; but with all these changes the individual fibres always remain distinct.

The nerve fibres are of two kinds,—the one white, tubular, medullated, and dark bordered, the other grey or pale, and non-medullated. In most nerves both kinds of fibres are to be met with, but the white are most numerous in, and are characteristic of, the nerves of the cerebro-spinal system, while the grey are found chiefly in, and characterise, the nerves of the sympathetic system. The nerves of voluntary muscles have very few grey fibres, usually not more than one in ten, while in the nerves of involuntary muscles the grey fibres immensely predominate.

The white or medullary fibres constitute the white portion of the brain and spinal cord, and the nerves. They differ considerably in size from $\frac{1}{12000}$th or $\frac{1}{14000}$th to $\frac{1}{1500}$th or more of an inch in diameter, being largest in the trunks and branches, and becoming smaller as they enter the brain or spinal cord, and generally also towards their other extremity. Each fibre is a tube filled with partly fluid contents. The outer covering is a thin, delicate, transparent membrane, commonly called the "neurilemma" or "primitive sheath". In a perfectly fresh nerve the contents of this sheath has the appearance of a clear, homogeneous, oil-like, or fatty fluid; but in a short time, through exposure, a sort of coagulation or congelation appears to take place, when the outer portion becomes white, shining, and opaque, and is known as the "medullary sheath" or "white substance of Schwann," while in the centre is a thread of greyish white matter called the "axis cylinder". This does not exceed $\frac{1}{100000}$th of an inch in diameter, is of an albuminous nature, and possessed of some degree of firmness and elasticity. In some nerves, at least, it appears longitudinally striated, which has led to the opinion that it is com-

posed of a number of fibrillæ or minute fibres. It is undoubtedly the most essential portion of the nerve, being that which is always present, and being continuous with the nerve cells at one extremity and the peripheral end organs at the other, while the white substance is rarely present at the extremities. Often before its final termination it breaks up into subdivisions, and acquires more or less the character of grey fibres. The office of the white substance would appear to be to act as an insulator to the axis cylinder.

The non-medullated fibres are composed of pale grey translucent flattened bands from $\frac{1}{3000}$th to $\frac{1}{8000}$th of an inch in diameter, and resemble in appearance the axis cylinder of medullated nerve fibres. Like the latter, too, when carefully examined, they present a delicate fibrillated appearance, and are likewise supposed to be composed of numerous extremely delicate fibrillæ. They form the principal part of the trunk and branches of the sympathetic nerves, and are mingled in various proportions in the nerves of the cerebro-spinal system.

The cerebro-spinal centre is that part of the nervous system which is contained within the bony cavities of the skull and spinal column. The principal parts contained within the skull or cranium are the cerebrum, cerebellum, corpora quadrigemina, corpora striata, optic thalami, crura cerebri, pons varolii, and medulla oblongata; while within the spinal column is the spinal cord.

The *cerebrum*, or brain proper, is the organ by which the highest mental operations are carried on, and it appropriately occupies a position above all the other organs which are subordinate to it. It is situated in the upper part of the skull, and forms about five-sixths of the entire mass of nervous matter contained within

hat cavity. It is ovoid in shape, but is irregularly lattened on its under surface; and is divided into two ateral halves, termed hemispheres, by the great longiudinal fissure which passes quite through its substance efore and behind, but in the middle is interrupted by transverse portion of white matter termed the *corpus allosum*, which connects together the two hemispheres. Each hemisphere is subdivided into three lobes,—the nterior, middle, and posterior,—but it is only on the nder surface that these are distinctly marked. The nterior and middle lobes are separated from each other y a deep fissure called the *fissura sylvia*, which extends bliquely backwards to a considerable depth. The niddle and posterior lobes are not so clearly marked ff, but the posterior is generally considered to be that ortion which lies directly over the cerebellum.

The surface of the hemispheres presents numerous ortuous eminences, named convolutions, which are eparated from each other by deep grooves or furrows. n this way a much greater extent of surface is obtained n the same space; and as the grey matter forms the uter surface of the cerebrum, lining the various fissures s well as covering the different convolutions, it follows hat the greater the number and depth of these, the reater the extent of the grey matter. This is usually egarded as the seat of the higher mental operations, nd hence we find the convolutions more numerous nd marked as the mental powers are more highly eveloped.[1] They are more prominent in man than in ny of the lower animals, in the civilised man than in

[1] "From these premises it may be laid down as a just conclusion at the convolutions of the brain are the centres of intellectual tion, or, more strictly, that this centre consists in that vast sheet of scular matter which crowns the convoluted surface of the hemiheres."—*Todd and Bowman.*

the savage, and in the man of mature years than in the infant. The more highly developed the brain, the more irregular and tortuous appear the convolutions; but on comparing different brains, and in particular the brains of different animals, they are found to possess a certain regularity and plan.

The grey or cortical surface of the cerebrum is about one-fifth of an inch thick, and is arranged in layers, of which there are usually reckoned six, and which are white and grey alternately, a white layer being the outermost. The white layers are largely composed of nerve fibres running in various directions—some towards the surface, others more or less parallel to it. They become gradually smaller as they approach the surface, and in the external layer are of extreme minuteness, disposed in layers one over another, and crossing each other in various directions. In this last the nerve cells are small and not very numerous, nor are they very numerous in the other white layers. They are, however, very abundant in the grey layers, many of them being of considerable size, and are chiefly remarkable for the number of processes which they send out, and which serve to connect them with the nerve fibres.[1]

[1] The nerve cells of the cortical substance "lie in juxtaposition and enter into close relationship one with another. They are further arranged in regularly stratified zones one above another; and they form by their prolongations a tissue which is everywhere continuous, and thus produces unity of action between this multitude of isolated elements." Thus "the cortical substance represents an immense instrument, constituted of nervous elements, each gifted, it is true, with its proper individuality and yet intimately connected one with another. The series of cells arranged in stratified zones, and the connections of the different strata communicating one with another, imply the idea that the nervous activities of each zone may be isolatedly evoked; that they may be associated one with another; that they may be modified in passing from one region to another, according to the nature of the intermediary cells brought into play; that, in a word, nervous actions, like vibratory undulations, must propagate

'he cells are not sensitive to pain, but have a sensibility f their own to the ideas that are fashioned in them.[1]

The white or medullary substance forming the in- erior of the brain is composed wholly of nerve fibres, which enter the grey substance more or less at right ngles to its surface, and at the other end converge owards the corpora striata and the optic thalami, thus orming a communication between these bodies and the uter grey matter. Besides these fibres there are ertain groups of others, some extending transversely,

iemselves through one point of contact after another, following the irection of the organic substance that underlies them, either trans- ersely or vertically, from the superficial to the deep regions, and *ice versâ.*" Further, we may "suppose that the sub-meningeal egions, principally occupied by the small cells, may be specially onnected with the phenomena of sensation, while the deeper regions, ccupied by groups of large cells, may be considered as the most nportant regions that give rise to motor phenomena. . . . It is ecessary, then, that between these two poles of the system there iall be a simultaneous co-operation. . . . It is also necessary iat at the moment when the excitation from the external world rrives in the sensorium it shall be introduced methodically, and ı a gradual manner; that it shall work its passage independently; nd that at the moment at which it is there deposited it shall vibrate lone, and alone imprint the records of its presence upon the plexuses f the sensorium. . . . It is by means of this organic mechanism iat movement and life are incessantly spread through the plexuses f the cerebral cortex; that excitations of all kinds spring up in their iinute structure on the arrival of external impressions; that the iaterials of the past become associated with recent ideas and im- ressions; and that, in a word, those marvellous phenomena, so ıstantaneous and so varied, presented by the activity of the brain re developed. . . . By means of these connections our ideas are ssociated, grouping themselves methodically into contemporary eminiscences, appealing one to another when the first link of the iain has been struck."—*J. Luys.*

[1] "They live, they feel, and, what is more, they remember, for ien it is that this new property of preserving records of past experi- nces, appearing in full force, gives a special character of permanence all the excitations that arrive, and enables them to survive them- elves, to prolong their existence in the form of memories, and to be iarked in the calendar of our sensitive impressions with a special)-efficient of pleasure or pain."—*J. Luys.*

and serving to connect the two hemispheres, others running longitudinally and connecting the anterior with the posterior lobes of the same hemisphere. Of the former the principal group forms the *corpus callosum*, or great transverse commissure, a large mass of white fibres very closely interlaced together, and stretching from one hemisphere to the other.[1] Though it is impossible to trace the fibres, there is reason to believe that they extend to the outer grey substance. Besides these there are numerous fibres connecting the different convolutions and different parts of the same convolution.

From its highly organized structure, its size, position, and the large quantity of blood which it receives, there can be little doubt that the cerebrum is the seat of man's highest powers, the material organ of the faculties of the mind.[2] It also possesses a direct or indirect

[1] "Cases have occurred in which this has been nearly or even entirely deficient in man, and it is significant that the chief defect in the characters of such individuals has been observed to be a want of forethought, *i.e.*, of power to apply the experience of the past to the anticipation of the future."—*Dr. Carpenter.*

[2] "It is now universally acknowledged that intellectual power depends upon the size, quality, and convolutions of the brain; and it is further known how small a cerebral change may convert genius into madness."—*Dr. Cunningham.* "An inflammation of the brain causes delirium or mania; an extravasation of blood, stupefaction and unconsciousness; a permanent pressure upon the brain, weakness of intellect, idiocy, &c."—*Büchner.* "The grey matter of the hemisphere is associated with the manifestation of intelligence in its various forms. . . . If the grey matter be suddenly injured or submitted to compression, as by a blow, causing fracture and depression of a portion of the skull, or the effusion of fluid consequent on inflammation, unconsciousness is a certain result. So long as the pressure continues there is no consciousness; if it be removed consciousness may soon return."—*Prof. M'Kendrick.* "Who could have believed that the hemispheres may be pricked, torn, cut, and even burnt by the actual cautery in the living animal without producing the slightest feeling; yet all observation and experience concur in proving that this is unquestionably the fact."—*Magendie.* "When

ontrol over nearly all the actions of the physical frame. he grey matter here, as in other parts of the nervous rstem, is doubtless the source of nervous power, while ie white fibrous matter serves to conduct impressions. he external position of the grey matter here, contrary the general arrangement in nerve centres, admits of s being abundantly supplied with blood, and also fords a freer and more extensive communication with ie nerve fibres. It is estimated that there are from)0,000,000 to 1,200,000,000 of nerve cells in the brain r the generation of nerve force, and the moulding, shioning, and storing up of our ideas, each having a parate existence, but all acting in subordination to ie requirements of the organs. They are connected gether by probably from 4,000,000,000 to 5,000,000,000 fibres which convey impressions from one to another nd bring them into combined action.[1] The fibres

e hemispheres are removed the following results are observed: rst, the two higher senses, sight and hearing, are lost. Secondly, emory and all the powers characteristic of intellect or thought e abolished. Thirdly, volition, in the shape of purpose and fore- ought, is extinguished. . . . Fourthly, there is still a power of complishing many connected movements. An animal may walk, im, or fly, but there is no tendency to *begin* these actions. Fifthly, ere remains an inferior form of the sensibility of the three lower nses, touch, taste, and smell. By stimuli applied to these senses flex movements may be excited."—*Prof. Bain.*

[1] Professor Bain estimates that the number of cells in the grey vering of the hemispheres may amount to 1,200,000,000. "As ery cell is united with at least two fibres, often many more, we ay multiply this number by four for the number of connecting res attached to the mass, which gives 4,800,000,000 fibres. Assume e respective numbers to be (corpuscles) 1,000,000,000 and (fibres))00,000,000, and make our comparison with our acquisitions as llows:—With a total of 50,000 acquisitions evenly spread over the iole of the hemispheres, there would be for each nervous grouping the rate of 20,000 cells and 100,000 fibres. With a total of 200,000 quisitions of the assumed types, which would certainly include the ost retentive and most richly endowed minds, there would be for ch nervous grouping 5,000 cells and 25,000 fibres." Hence "there

which proceed to the optic thalami and corpora striata form the means of communication between the cerebrum and the other parts of the body.

The *cerebellum*, or little brain, is situated under the posterior lobes of the cerebrum, or brain proper, at the base of the skull. It consists of an elongated central body, called the vermiform process, and two large lateral masses termed hemispheres. It is composed of white and grey matter, the latter being arranged in the form of laminæ on the surface of the lobes into which it is divided. When cut across it presents somewhat of the form of a tree, the internal white matter forming the stalks and the grey matter the leaves, and hence it has been termed *arbor vitæ*, or the tree of life. Besides the grey matter on the surface, there is near the centre of each hemisphere a small capsule of grey matter enclosing white matter in its interior, called the *corpus dentatum*. Three pairs of crura, peduncles, or tracts of fibres, connect the cerebellum with the cerebrum, the medulla oblongata, and the pons varolii respectively. The cerebellum is generally regarded by physiologists as the seat of the muscular sense, regulating and combining the different movements of the muscles, and informing the mind of their various states and positions.[1]

is no improbability in supposing an independent nervous track for each separate acquisition".

[1] "One office of the cerebellum is to combine the action of the voluntary muscles for the purpose of locomotion."—*Sir B. Brodie.* "The cerebellum co-ordinates movements guided by vision, or combines the general movements of the body rendered necessary by special actions ordered by volition."—*Dr. Bastian.* "Galvanic irritation according to Ferrier, caused movements of the eyeballs and other movements indicative of vertigo. . . . In conclusion, therefore, it may be stated that the function of the cerebellum is to co-ordinate the muscular movement of the eye-balls with reference to binocular vision and of the muscles generally in locomotion; but the

The *corpora quadrigemina* are four rounded masses ituated near the cerebellum, with which they are con-ected by the superior peduncles of that organ. They re also connected with the optic thalami in front. 'he two anterior are the *nates*, the two posterior the *stes*. They are generally regarded as the centre of the ense of sight,—their destruction producing blindness. 'ach is composed of white substance on the surface nd grey matter underneath. Lying in front of and etween the nates, and connected with the optic tha-mi by two small peduncles, is a small mass of grey latter about the size of a small cherry stone, called e *pineal gland*, and noted as being the part considered y Descartes to be the seat of the soul.

The *optic thalami* and *corpora striata* are four large odies composed of white and grey matter, situated at e base of the cerebrum, and from which fibres radiate the convolutions on the surface of that organ. The ptic thalami are two large, firm, oblong bodies nearly n inch and a half long and three-fourths of an inch 'ide and deep. Anteriorly they are connected with e corpora striata, and posteriorly by small peduncles 'ith the pineal gland and the nates. The corpora riata are two pear-shaped bodies, obtuse and ap-roaching each other in front, but becoming smaller nd receding from each other as they extend back-'ards. When laid open the grey matter is seen to be reaked with white, whence the name.

These bodies are sometimes termed the cerebral anglia, and are regarded by Dr. Carpenter as the ue *sensorium*, or that portion of the brain through 'hich the mind becomes conscious not only of sensa-

echanism by which this is accomplished is unknown."—*Prof. I'Kendrick.*

tions, but also of its own intellectual operations,—th cerebrum, in his view, being destitute of consciousnes as it is of sensation. Nearly all the fibres that connec the cerebrum with the medulla oblongata, and so wit the spinal cord and the different parts of the body, pas through these ganglia. The fibres passing through th optic thalami are sensory, while those passing throug the corpora striata are motor. M. Luys distinguishe four small isolated ganglia of grey matter situated in line, one behind another, in each thalamus. The firs of these, the anterior and most prominent, he regard as connected with the sense of smell; the second wit sight; the third with sensibility; and the fourth wit hearing.[1] The motor action of each of the corpor striata passes to the muscles of the opposite side o the body, the decussation taking place in the medull oblongata.[2]

[1] "From a physiological standpoint the optic thalami are inter mediary regions interposed between the purely reflex phenomena c the spinal cord and the activities of psychical life. By their isolate and independent ganglions they serve as points of condensation fo each order of sensorial impressions that finds in their network o cells a place of passage and a field for transformation. . . . Thes are then the sole and unique open gates by which all stimuli fron without, destined to serve a *pabulum vitæ* for these same cortica cells, pass, and the only means of communication by which th regions of psychical activity come into contact with the externa world."—*J. Luys.*

[2] "The corpus striatum is the motor ganglion for the entire oppo site half of the body. It translates volitions into actions or puts i execution the commands of the intellect; that is, it selects, so t speak, the motor nerve nuclei in the medulla and cord appropriat for the performance of the desired action, and sends down the im pulses which set them in motion. These impulses are transmitte through fibres, and the fibres must start from cell-processes in th corpus striatum. A given movement therefore must be represente in the corpus striatum by a group or groups of cells giving off down ward processes which become fibres of the motor tract of the cord."— *Dr. Bastian.* The corpus striatum "is a common territory, int which the cerebral, cerebellar, and spinal activities come in successio

Two short, thick, rounded cords called the *crura cerebri* connect the optic thalami and the corpora striata with the pons varolii. They are composed chiefly of white fibres, but have in the interior a semilunar mass of dark-grey matter. The inferior or more superficial fibres are continuous with those of the anterior pyramids of the medulla oblongata, and the superior or deeper with the lateral and posterior pyramidal tracts and the olivary fasciculus. The crura cerebri are regarded principally as conducting organs.

The *pons varolii* occupies a comparatively small part of the encephalon, and is situated above and in front of the medulla oblongata, with which it is continuous. It is composed of transverse and longitudinal white fibres, interspersed with a quantity of diffused grey matter. The transverse fibres, with few exceptions, communicate with the cerebellum by means of the middle crura or peduncles, while the longitudinal fibres connect the medulla oblongata with the cerebrum. Its purpose is evidently to conduct impressions from one part to another.

The *medulla oblongata* is mostly contained within the cavity of the cranium, but also partly in the spinal

o be combined. . . . It is in the midst of its tissues that the influence of volition is first received at the moment when it emerges from the depths of the psycho-motor centres of the cerebral cortex. There it makes its first halt in its descending evolution, and enters into a more intimate relation with the organic substratum destined to produce its external manifestations—in one word, materialises itself. From this moment it comes into intimate contact with the innervation radiating from the cerebellum, and it is now no longer itself, no longer the simple purely psycho-motor stimulus it was at its origin. It is associated with this new influence which gives it somatic force and continuity of action. It then passes out of the brain by means of the peduncular fibres, combined with a new element, and pursuing its centrifugal course, it is finally extinguished here, thereby setting in motion the different groups of cells of the spinal axis, whose dynamic properties it thus evokes."—*J. Luys.*

column, and forms the connection between the cord and the encephalon. It is somewhat pyramidal in form, tapering towards its connection with the spinal cord, and is partially divided into two lateral and symmetrical halves by an anterior and posterior fissure, as is the case with the cord. It is composed of both white and grey matter, the former being arranged partly in external columns and partly in fasciculi traversing the inner grey matter, which is variously disposed in masses and laminæ. The columns are continuous with those of the cord, but are more prominent, and separated by deeper grooves, and increase in size as they proceed towards the brain. The anterior columns receive the name of the *anterior pyramids*, the posterior that of the *restiform bodies;* and at the posterior part of the latter, immediately on each side of the posterior median fissure, a small tract is marked off by a slight groove, and named the *posterior pyramids*. Near the upper part of each of the two lateral columns is a small oval mass of grey matter called the *olivary body*. "The anterior pyramid of each side, although mainly composed of continuations of the fibres of the anterior columns of the spinal cord, receives fibres from the lateral columns both of its own and the opposite side. . . . Thus composed, the anterior pyramidal fibres, proceeding onwards to the brain, are distributed in the following manner: 1. The greater part pass on through the pons varolii to the cerebrum. A portion of the fibres, however, running apart from the others, joins some fibres from the olivary body, and unites with them to form what is called the olivary fasciculus or fillet. 2. A small tract of fibres proceeds to the cerebellum. The lateral column on each side of the medulla, in proceeding upwards, divides into three

arts—outer, inner, and middle, which are thus disosed of: 1. The outer fibres go with the restiform ract to the cerebellum. 2. The middle decussate cross the middle line with their fellows, and form the hief part of the anterior pyramid of the opposite side. . The inner pass on to the cerebrum along the floor f the fourth ventricle on each side, under the name of he *fasciculus teres.* The fibres of the restiform body eceive some small contributions from both the lateral nd anterior columns of the medulla, and proceed hiefly to the cerebrum, but that small part behind alled the posterior pyramid is continued with the isciculus teres of each side along the floor of the ourth ventricle to the cerebrum."—*Kirkes' Physiology.*

The functions of the medulla oblongata are similar o those of the spinal cord, but it has others in addiion of the greatest importance. It contains tracts of ensory and motor fibres, as well as a series of reflex entres for special movements. Among these last is ie centre which regulates the respiratory movements, n injury to which, by stopping respiration, produces istant death; which the removal of the entire brain bove, or of the cord below, does not effect.[1] The

[1] "The most important function of the medulla is to cause and to gulate the respiratory movements, and the point in which the spiratory centre is situated is called the vital knot. The same gan also regulates the heart's action. The medulla is also the ntre of action for the bloodvessels. The insensible perspiration the skin is likewise under its influence. The movements of vallowing, which require for their proper execution a co-ordinated tion of the lips, tongue, palate, and gullet, are likewise under the mediate influence of the medulla. The same organ contains a ntre for the physiognomical play of the muscles of the face, and other for articulate speech—that is, the pronunciation of vowels id consonants in such fashion as to form words. All these different nctions of the medulla are automatical or mechanical—that is, dependent of volition, intelligence, or any other of the higher ental processes—and they may therefore continue where the higher

motor fibres occur chiefly in the anterior pyramids and here cross or decussate, so that disease or injur affecting the motor fibres of one hemisphere of th brain causes paralysis of motion on the opposite sid of the body. Those supplying the face cross in th pons varolii. Regarding the transmission of sensor impressions nothing is known with certainty.

The cerebrum and other parts within the craniun are enveloped in three membranes—the dura mater the arachnoid membrane, and the pia mater. Th first of these, which is the outermost, is of great den sity and firmness, its component fibres interlacing eacl other in all directions. The inner surface is smootl and shining, while the outer, which adheres to th bones of the cranium, is rough and irregular. Th membrane sends out several folds or processes whicl

centres in the brain have been either experimentally removed o disorganised by disease."—*Dr. Althaus.* It "receives directly th auditory impressions, the impressions of taste, and indirectly through the corpora quadrigemina, is affected by visual impressions meanwhile sending impulses to the various muscles of the eyes, th face, the jaws, and the mouth. By it the movements of all fou limbs are combined in joint acts; and by simultaneously regulatin them it makes the head and jaws co-operate with the limbs. Th various impressions and muscular motions implied by the act o swallowing it brings into due relation. Receiving the respirator stimulus, it emits the stimuli to those muscles which enlarge an diminish the thoracic cavity, so causing inspiration and expiration and as a consequence it is the centre which, disturbed by the mor violent irritations of the respiratory surface, sends out to the respi ratory muscles those more violent impulses which cause coughin and sneezing, to which may be added, as actions belonging to the same class, crying and yawning. Lastly, through the pneumogastric nerve, it controls the action of the heart and the actions of othe viscera. . . . This is not all. Being the centre which initiates and directs involved and extensive bodily actions, entailing rapid expen diture, it is the centre in which the demand for materials is indi cated; and hence it becomes the regulator of the circulation, of the aeration of the blood, and of the visceral actions generally."—*H. Spencer.*

lescend between certain portions of the brain to support or protect them. The principal of these are the *alx cerebri*, which extends from the fore to the back part of the skull, passing into the great longitudinal issure which separates the two hemispheres of the erebrum; the *tentorium cerebelli*, extending across the ack part of the skull, and separating the cerebrum rom the cerebellum; and the *falx cerebelli*, passing own between the two lobes of the cerebellum. The econd or middle of the three membranes is an extremely thin and delicate substance called the *arachnoid*, rom its fancied resemblance to a spider's web. It losely lines the dura mater through its whole extent, nd is reflected upon the pia mater, with which it is verywhere in contact, in some parts closely, in others, specially at the base of the brain, very loosely. The *ia mater*, or innermost covering of the brain, is a delicate vascular membrane, which closely envelops the ncephalic mass, dipping down between all the convoitions, following them in their windings, and lining ven the minutest fissures. It is richly supplied with loodvessels, which ramify upon its surface, and send ninute branches into the grey substance of the brain.

The quantity of blood that proceeds to the brain is ery great, being estimated at one-fifth or one-sixth art of the entire amount contained in the body.[1] pecial provisions are also made to prevent any irregu-

[1] "It is calculated that the brain of man receives about a fifth or sixth of the whole blood in circulation; although its weight is not iore than a fortieth or fiftieth part of that of the entire body."—*r. Carpenter*. "The functional activity of the brain depends on ie copious supply of arterial blood. It is computed that one-fifth of ie whole quantity in circulation is sent to this organ."—*Dr. Draper*. It has been computed that five times as much blood circulates in ie grey or corpuscular substance as in the white or fibrous subance."—*Prof. Bain.*

larities or interruption of the supply, for such is the importance and delicacy of this organ that any great increase in the quantity of blood sent to it, or any interruption of the supply, would result in immediate death. There are four large arterial trunks which serve to convey the blood to the brain—the two internal carotids and the two vertebral. So large are these vessels, and so ample their means of intercommunication, that even if the circulation in one of them be impeded or stopped, the others may supply its place with little diminution of the general flow. The veins do not accompany the arteries here, as in other parts of the body, but are widely dispersed, and ultimately form large, tortuous canals.

From the position of the brain in the interior of a hard, bony case, it is evident that any sudden increase in its volume, either from an over-supply of blood or any other cause, would be productive of very serious consequences to its delicate structure, were not special provision made in order to meet it. This is done by means of a fluid which exists between the layers of the arachnoid membrane in the brain and spinal cord known as the *cerebro-spinal fluid*. The amount usually averages about 2 oz., but in cases of atrophy or wasting of the brain as much as 12 oz. may be found, while in cases where the brain has undergone an increase there is either a diminution or a total absence of this fluid. Its presence also doubtless has the effect of preventing an undue expansion of the bloodvessels.

The weight of the entire mass of brain differs considerably in different individuals. In the adult male it usually ranges between 40 and 60 oz., the average being about 50, but in some cases it reaches as high as

4 or 65, and in others it is as low as 33 or 34 oz. n the adult female the weight usually ranges from 36) 50 oz., the average being about 45, but it has been)und as high as 56 and as low as 31. In cases of liocy the amount is sometimes much below this, and s low a weight as 20 oz. has been recorded.[1] The verage weight of the brain in proportion to that of the ody is about 1 to 36. As regards the weight of different arts of the brain, the cerebrum averages in the adult ale nearly 44 oz., and in the adult female 38$\frac{3}{4}$; the erebellum in the male about 5$\frac{1}{4}$, and in the female about $\frac{3}{4}$; the pons varolii and medulla oblongata together bout 1 oz., being rather larger in the female than in e male.

Physiologists differ as to the time when the brain tains its full size. Sir William Hamilton and others ace it as early as the seventh or eighth year. Gall id Spurzheim, and phrenologists generally, maintain at the brain continues to grow till about the fortieth ear, and this appears to be nearest the truth. "It)pears that in general the weight of the brain increases pidly up to the seventh year, then more slowly to etween sixteen and twenty, and again more slowly to etween thirty-one and forty, at which time it reaches s maximum point. Beyond this period there appears

[1] "When the weight of the brain falls below a certain minimum ndard, the possession by its owner of anything like ordinary man intelligence seems to be impossible. Gratiolet, without ecifying the sex, supposed this lower limit of weight to be about $\frac{3}{4}$ oz. Broca places it somewhat higher, fixing upon 32 oz. as the nit for the female and 37 oz. as the lower limit of weight for the ale brain compatible with ordinary human intelligence. The ain-weight of idiots may, however, and frequently does, fall far low the limits above assigned."—*Dr. Bastian.* "It would appear at in general throughout the human race no brain under 30 oz. sufficient for the exercise of its normal functions."—*Dr. Allen iomson.*

a slow but progressive diminution in weight of abo one ounce during each subsequent decennial period. —*Quain's Anatomy.*[1] We have here a physiologic basis for what is popularly believed to be a fact, th the mind reaches its maximum about the age of fort and that no great work has been accomplished b any one after that age, the basis of which was n laid before.

The *spinal cord* forms the means of communicatio between the brain and most other parts of the body Through it impressions made on the sensitive spina nerves are conveyed to the brain, and through it, to the stimulus sent from the brain is conducted to th motor spinal nerves in order to excite the action of th muscles. It may also be regarded as a series of gangli or nervous centres united together in one continuou column. In consequence of its continuity and it direct connection with the brain, most of its operation are carried on consciously, and are under the control o the will; but at the same time each of the nervou centres of which it is composed is capable of receivin impressions and giving out stimuli independently of th will or of consciousness.[2] Hence if any part of th cord be destroyed, and communication with the brai be thereby interrupted, sensation and voluntary motio will cease in those parts connected with the cord below the seat of the injury, but the detached portion of th

[1] "From forty to fifty years there is a slight diminution in weigh and a greater one between fifty and sixty. After sixty years the rat of decrease is still greater; the process of decay becomes more an more rapid, and thus in the eighth decade of existence the averag weight of the brain is less by more than 3 oz. than it was in th fourth decade. In the aged, on the average the weight of the brain decreases *pari passu* with the intelligence."—*Dr Thurnam.*

[2] "Every segment of the spinal cord may act separately as a independent centre; every segment is a little brain."—*G. H. Lewes.*

rd will still retain the properties of an ordinary nerve ntre and respond to stimuli acting on it.[1]

The spinal cord is composed of both white and grey rvous matter, the former situated externally, and nstituting its chief portion, the latter disposed in the terior. When the cord is cut transversely, the grey bstance is seen arranged in the form of two crescental asses, one occupying each lateral half, and the two ing connected together by a transverse band of the me material.[2] The posterior horns are long and rrow, and approach the surface, while the anterior e considerably shorter and thicker. The cord is vided longitudinally into two exactly symmetrical lves by an anterior and a posterior fissure, the two lves being united in the middle by a commissure. he posterior fissure is deeper but less wide and distinct an the anterior. Each half is marked on the sides two longitudinal furrows which divide it into three rtions or columns,—an anterior, a middle or lateral, d a posterior. The entire cord is, like the brain, veloped in three membranes,—an outer, the dura ater; an inner, the pia mater; and the arachnoid embrane between the two.

The nerves of the spinal cord consist of thirty-one irs issuing from the sides of the cord through its whole ngth, and corresponding in number to the interverte-

1 "When the spine is injured or divided there are two centres, d the parts above are not sensitive to impressions on the parts ow; nor are the parts below sensitive to impressions on the parts ove; but each segment is sensitive to its own affections. The ralytic man does not feel the prick on his leg, but his leg feels it." *G. H. Lewes.*

2 "The cells are larger and more numerous in the anterior grey tter of the spinal cord than in the posterior. They are of various es, but remarkably multipolar and intimately connected with each ier and with the roots of the spinal nerves by means of their merous branching processes."—*Dr. Laycock.*

bral foramina through which they pass. Each nerve arises by two roots, an anterior and a posterior, the latter being the larger. The anterior root springs from the groove between the anterior and lateral columns of each half of the cord, and contains only efferent or motor fibres; the posterior rises just in front of the groove between the lateral and posterior columns, and consists entirely of afferent or sensory fibres. "The roots emerge through separate apertures of the sheath of the dura mater surrounding the cord, and directly after their emergence, while the roots lie in the intervertebral foramen, a ganglion is formed on the posterior root. The anterior root lies in contact with the anterior surface of the ganglion, but none of its fibres intermingle with those of the ganglion. But immediately beyond the ganglion the two roots coalesce, and by the mingling of their fibres form a compound or mixed spinal nerve which, after issuing from the intervertebral canal, divides into an anterior and posterior branch, each containing fibres from both roots."—*Kirkes' Physiology*.

Of the root fibres of the nerves, some pass horizontally or obliquely into the substance of the cord while others proceed upwards or downwards in it. Many of them may be traced into the central grey substance and terminate there; and the experiments of Brown-Sequard make it probable that the grey substance is the channel by which sensitive impressions are conducted to the brain. He has shown that the posterior columns are not, as was previously generally supposed, the course which they follow, but that they pass into the grey substance, through which alone, or aided by the anterior columns, they reach the brain. Further, he has proved that impressions are not con-

veyed along that half of the cord by which they enter, but almost directly cross over to the other, and by this pass to the brain. Thus it is that division or disease of one posterior half of the cord is followed by loss of sensation in the parts on the opposite side of the body. The motor nerves also decussate, but this takes place, not in the cord itself, but in the medulla oblongata. After decussation the motor impulses "first enter the cord by the lateral tracts and adjoining grey matter, and then pass to the anterior columns and the grey matter associated with them".—*Kirkes' Physiology.*[1]

There are certain nerves which have their origin in the brain, and are hence commonly known as cerebral or cranial nerves. They are mostly connected with the organs of the senses, and are usually reckoned as nine pairs, although, strictly speaking, the number is twelve, the seventh forming two and the eighth three pairs. They are named numerically in the order in which they proceed from the brain. The *first pair*, or *olfactory*, are connected with the under surface of the anterior cerebral lobe by three roots, and, unlike other nerves, consist of a large portion of grey matter mixed

[1] "While motor influences descend through the columns of the cord on the same side as the roots of the nerves upon which they act, sensory impressions (at least those of pain and touch) ascend on the opposite side from that on which the posterior or sensory roots have entered. Thus it appears that the most of the fibres in communication with those of the sensory roots cross at once to the opposite side of the cord, as may, indeed, be seen in the grey commissure, while the motor fibres remain on the same side. But at the upper part of the spinal marrow, or rather when they have just entered the medulla oblongata, the motor columns suddenly cross, in more or less divided bundles of fibres, from one side to the other. This occurs in the so-called decussation of the pyramids, which consists essentially in the oblique passage across the middle plane of a considerable part of the lateral columns of the cord containing its chief motor fibres into the opposite anterior pyramids of the medulla oblongata." —*Dr. Allen Thomson.*

with white fibres. Each nerve afterwards swells ou into an elongated oval mass of nervous matter callec the *olfactory bulb,* which rests upon the cribrıform plate o the ethmoid bone, through which a number of smal soft nerves descend to the *Schneiderian* membrane o the nose, the seat of smell. The *second pair,* or *optic* arise from the optic thalami, the corpora quadrigemina and the corpora geniculata, and meet each other at th optic commissure, where they partially decussate, th outer fibres continuing onwards to the eye of the sam side, while the inner cross over towards the eye of th opposite side. They then pass into the orbits, pene trate the eyeballs, and expand into the retina, tha part of the eye by which visible impressions are take up. The *third pair,* or *motores oculi,* have their origi from the inner surface of the crura cerebri, and, enterin the orbits, are distributed to most of the muscles tha move the eyeballs. The *fourth pair,* or *trochlearis* spring from the corpora quadrigemina, and pass into th orbits governing the movements of the trochlearis o oblique muscle of the eye. The *fifth pair, trifacial* o *trigeminal,* arise from the side of the pons varolii, eac by two distinct roots, as in the spinal nerves. Th larger and softer root, which is sensitive, enters th Gasserian ganglion, from which three branches o divisions of the nerve are given out. The smaller o motor root has no ganglion, and passes under th Gasserian ganglion to join the third branch or divisio which issues from it. The first and second branches o the larger root are purely sensitive. The third branch being joined by the motor root of the nerve, is of cours both sensitive and motor. The sensitive branche terminate in the face, and communicate sensibility to that and the fore part of the head, as well as to the eye

ıe nose, the ear, and the mouth, and endow the
re part of the tongue with the powers both of touch
ıd taste. The third branch is distributed to the
uscles of the jaws, and governs the movements of the
astication. The *sixth pair*, or *abducent*, have their
igin between the pons varolii and medulla oblongata,
ceiving fibres from both parts, and, entering the orbit,
e distributed to the external rectus muscle of the
eball. The *seventh pair* arise from the medulla oblon-
ıta, and are composed of two parts, the *portio dura* and
e *portio mollis*, which are in reality separate nerves,
ing distinct in their origin, distribution, and function.
he portio dura, or facial, is motor, and is distributed to
e different muscles of the face, directing and regu-
ting their movements. The portio mollis, or auditory,
oceeds to the internal parts of the ear, and serves to
llect and transmit the influences of sound. The *eighth*
ir arise from the medulla oblongata, and are divided
to three branches,—the *glosso-pharyngeal*, the *par*
gum, or pneumogastric, and the *accessory*. The first
these is distributed to the root of the tongue and
ıarynx, ministering to taste and touch, and also
sisting in the act of deglutition. The par vagum, so
lled from its wandering course, is both sensitive and
otor, and the most widely distributed of the cranial
rves, sending branches to the neck, lungs, and stomach.
also forms important connections with the sym-
thetic system of nerves. The accessory or spinal
cessory nerve, so called from originating partly in the
inal cord, is motor, its principal branch, the external,
pplying the external muscles of respiration, and the
ernal adding motor filaments to the par vagum. The
th pair, or *hypo-glossal*, issue from the medulla oblon-
ta, and are distributed to the muscles of the tongue,

and regulate the movements of that organ in speec and deglutition. Of these nerves the olfactory, optic auditory, part of the glosso-pharyngeal, and the sub lingual branch of the fifth pair are nerves of specia sense; and the greater part of the fifth, and part c the glosso-pharyngeal, are nerves of common sensation Three of the others, the third, fourth, and sixth pairs are employed in regulating the movements of the eye ball.

Regarding the effects of exercise on the differen parts of the nervous system, we have not the sam direct evidence that we have concerning other parts o the body. We cannot see in nerve as in muscle, fo instance, an increase in size, and greater density an firmness, as the result of exercise, but there can scarcel be a doubt that such actually takes place.[1] All parts o the nervous system are known to be most abundantl furnished with bloodvessels for supplying them with nutritive materials, which shows that a large measur of waste is constantly taking place in their substance requiring to be constantly renewed.[2] With increase exertion we know that the rate of waste and renewal i

[1] "Many circumstances lead to the conclusion that in the nervous as in the muscular system, every vital operation is necessarily con nected with a certain change of composition, so that no manifestatio of nervous power can take place unless this change can be effected. —*Dr. Carpenter.*

[2] "Living tissues are in a state of continuous molecular renova tion, nervous tissue more than any other, and in nervous tissue th grey substance more than the white substance, as is shown by th excessive abundance of bloodvessels with which the former is line Since the modifications are persistent, the new material, the arrange ment of the molecules, must exactly reproduce the type which the replace."—*Th. Ribot.* "There is no part of the organism of man i which the reconstructive activity is so great during the whole perio of life as it is in the ganglionic substance of the brain. . . . It i moreover, a fact of great significance that the nerve substance specially distinguished by its reparative power."—*Dr. Carpenter.*

much accelerated.[1] Further, we know that the effects of well-directed exercise are the same here as in other parts of the body, producing increased power, skill, and dexterity, so that what was at first difficult becomes more and more easy by practice, till at length it may come to be a second nature. This holds true in the region of thought not less than in outward action.[2] Hence there is every reason to believe that the effects of exercise upon the nervous system are exactly the same as upon other parts of the body, producing first waste of substance, followed by an increased supply of nutritive material by which the part is enlarged in size, and acquires greater firmness and fineness of texture, becoming thus more suited for the performance of its special work.[3] Thus we have in judicious exercise the

[1] "The nervous substance is distinguished from all the other tissues by the very large proportion of phosphorus which enters into its composition . . . and one result of over-exercise of the nervous system is the elimination of an unusual quantity of salts containing phosphorus by means of the secretion of the kidneys."—*Sir B. Brodie.* "Sustained intellectual work is accompanied by a loss of phosphorised substance on the part of the cerebral cell in vibration," and "becomes at the same time the occasion of a local development of heat . . . appreciable by the instruments of the physical laboratory". —*J. Luys.* "Mosso has invented a method of registering the effect of thought on the circulation. He finds ideation accompanied by a contraction of the peripheral vessels proportionate to the degree of intellectual effort. A young man translating Greek showed greater contraction than when he was translating Latin."—*G. H. Lewes.* "It is only by supposing an idea to be accompanied by a correlative change in the nerve cells that we can explain the exhaustion following excessive mental work, and the breaking down of the brain in extreme cases."—*Dr. Maudsley.*

[2] "We train the muscles by exercise, and so we may train the different organs of the brain by proper exercise also, by intellectual work, by strengthening the power of the will, and by the regulation of our emotions."—*Prof. M'Kendrick.*

[3] ". . . All this leads us to the view taken by Müller and Engel, that the shape of the skull is everywhere essentially dependent on mental culture, and changes with it."—*Dr. Waitz.* "The brain

means of strengthening and improving the different parts of the nervous system, and overcoming weaknesses or tendencies to disease.[1] On the other hand, "continued repose of a nerve," says Dr. Hermann, "diminishes and destroys its irritability, and tends at last to fatty degeneration".

In order to form some idea of the immense number of elements concerned in effecting even common movements, let us take locomotion. "Is the starting-point an act of volition?"[2] asks M. Ribot. "Then the

grows to the mode in which it is habitually worked, just as the mechanism of our bodily movement shapes itself to the work we habitually call on it to perform."—*Dr. Carpenter.* "Mr. Webster told one of our greatest scholars that he had to change the size of his hat every few years. His head grew larger as his intellect expanded. Illustrations of this same fact were shown me many years ago by Mr. Deville, the famous phrenologist, in London."—*O. W. Holmes.*

[1] "The judicious exercise and cultivation of the mental faculties during youth, or at least of such as are most obviously developed, will actually gradually increase the dimensions, and improve the qualities, strength, and powers of the brain, and generally all the organs of intellect, in like manner as the muscular powers are by their due exercise strengthened and improved."—*Bostock: Physiology.*

[2] "In the first state of its outward course, it (*i.e.*, voluntary motor power) insensibly loses its original character of a purely psychical excitation to incorporate itself more and more with the organism, to materialise itself in a manner, and increase its dynamic power by the addition of a new nervous element—the cerebellar innervation, which, in the condition of a static force in permanent tension, is incessantly distributed in the plexuses of the *corpus striatum.* Thus reinforced, it continues its centrifugal course, and by means of the antero-lateral fibres of the axis (cerebral peduncles) it descends in the form of an interrupted current to excite the dynamic activity of the different motor nuclei of the spinal axis, which, like a series of apparatuses always ready to enter into action, only wait its arrival to develop their latent activity. . . . The processes which produce voluntary motion pass in their evolution through phases inverse to those of the processes of sensibility. While these last as they approach the central regions of the sensorium are purified and made perfect, becoming more and more *intellectualised* by the metabolic action of the different nervous media through which they are propagated, the former, on the contrary, conceived as psychical vibrations at the

impulse, originating, according to Ferrier in a particular portion of the cortex, traverses the white substance, reaches the corpora striata, passes through the crura cerebri, thence to the complicated structure of the medulla, where it passes to the other side of the body, descending the anterior columns of the spinal cord to the lumbar region, and then along the motor nerves to the muscles. This transmission is followed by a return to the cerebral centre through the posterior columns of the cord and the grey matter, the medulla, the pons varolii, the optic tract, the white substance, to the surface of the hemisphere." [1]

Here, then, we have a vast number of elements which are affected, and in which a change is produced, by so simple a process as an act of locomotion. This change is permanent, and constitutes, in our view, the basis of the memory of it. In its highest form, when we have the movement so clearly before the mind that we seem to be again enacting it, the seat of the memory is not confined to the brain, but embraces the whole track pursued by the original action. "The memory of an apple," to again quote M. Ribot, "is necessarily a weakened form of the perception of an apple. What does this perception suppose? A modification of the complex structure of the retina, transmission by the optic nerve through the corpora geniculata and the tubercula quadrigemina to the cerebral ganglia, then through the white substance to the cortex. This supposes the activity of many widely-separated elements.

moment of their genesis, amplify and are *materialised* more and more as they descend from the superior regions."—*J. Luys.*

[1] "Whatever opinion may be held with regard to the anatomical conditions of muscular sensibility, it is certain that the sensibility exists, and that it makes known the part of the body participating in movement, and permits us to regulate it."—*Th. Ribot.*

But this is by no means all. It is not a question of a simple sensation of colour. We see or imagine the apple as a solid object having a spherical form. These conceptions result from the exquisite muscular sensibility of our visual apparatus, and from its movements. Now, the movements of the eye are regulated by several nerves—the sympathetic, the oculo-motor and its branches. Each of these nerves has its own termination, and is connected by a devious course with the outer cerebral layer, where the motor intuitions, according to Maudsley, are formed. . . . Take the recollection of a word. If it is a written word it is again a question of visual perception, and is allied to the instance already cited. But if we take a spoken word, we find the complexity equally great. Articulate language supposes the intervention of the larynx, the pharynx, the lips, the nasal fossa, and consequently of many nerves having centres in different parts of the brain,—the spinal, the facial, and the hypoglossal. If we include auditory impressions in the memory of words, the complication is still greater. Then the cerebral centre must be united with Broca's convolution, and the island of Reil universally considered as the psychical centre of speech."[1]

[1] This is well expressed, but he seems to be led astray by the opinion held by medical men generally, that the changes effected by movements are confined to the nerve-centres, for he says in another place: "The movements that are instigated or actuated by a particular nervous centre do, like the idea, leave behind them residua which, after several repetitions, become so completely organised into the nature of the nervous centre that the movements may henceforth be automatic". In our view, the changes through which actions become automatic are not effected merely in the centres, but also in the nerves, and especially in the muscles. "Every kind of activity peculiar to a living body," says Dr. Carpenter, "involves a change of structure, and the formation of the newly-generated tissue receives such an influence from the conditions under which it originates, that all its subsequent activity displays their impress."

CHAPTER IV.

THE SENSES.

"If it were possible for a human being to come into the world with a brain perfectly prepared to be the instrument of psychical operations, but with all the inlets to sensations closed, we have every reason to believe that the mind would remain dormant like a seed buried in the earth."—*Dr. Carpenter.*

"That the powers of the understanding would for ever continue dormant were it not for the action of things external on the bodily frame, is a proposition now universally admitted by philosophers."—*Dugald Stewart.*

"Apprehension by the senses supplies directly or indirectly the material of all human knowledge, or at least the stimulus necessary to develop every inborn faculty of the mind."—*Helmholtz.*

"Even the highest ideas are slowly and gradually developed from the accumulation of sensual experience, and their truth is only guaranteed by the possibility of finding concrete examples for them in real existence."—*Virchow.*

"The activity of the mind is just as much the result of its consciousness of external impressions, by which its faculties are called into play, as the life of the body is dependent upon the appropriation of nutrient materials and the constant influence of external forces."—*Dr. Carpenter.*

"As we perceive more accurately, so we remember more correctly, judge more soundly, and imagine more truly."—*Dr. H. Maudsley.*

THE senses are the means by which the mind obtains its knowledge of the external world. Shut out from all direct communication with the outer world, it knows, and can know, nothing of what exists or is passing there, but what comes to it through the senses.[1] Its knowledge of what is external to itself is

[1] "We perceive no external object but by means of certain bodily organs, which God has given us for that purpose."—*Dr. Thos. Reid.* "Our knowledge is limited to our sensibilities. We are able to know what things affect our various sensibilities, or what may be compounded of these, and our knowledge extends no farther."—*Prof. Bain.* "We may, for want of a better name, say with Condillac that the internal primordial event which constitutes our knowledge is sensation."—*M. Taine.* "Knowledge is simply virtual feeling, the stored-up accumulations of previous experiences, our own and those of others."—*G. H. Lewes.*

therefore dependent upon the number, state, and condition of the sensory organs. A man with only one sense can know nothing of the external world but what is revealed to him through that one medium. If we suppose that sense to be sight, then the world will present itself to the mind only as it is seen,—no sound will ever issue from it, touch or feeling will give no information respecting it, it will yield no taste and no smell.[1] In like manner, the individual who is destitute of one or more of the senses is entirely cut off from such kinds of knowledge as naturally come in through these. Thus the man who is born blind can form no conception of colour, nor can one congenitally deaf have any idea of musical tones.[2] In every such case the man converses with the material world in utter ignorance of those properties of matter which can alone find entrance through these senses of which he is destitute.[3]

Even with all our senses there is every reason to believe that it is only a small portion of the outer world that is revealed to us by them, and that there exist around us, and contiguous to us, many objects that our present senses are unable to apprehend.[4] An additional

[1] "We can conceive ourselves as endowed with smelling, and not enjoying any other faculty. In that case we should have no idea of objects as seeable, as hearable, as touchable, as tastable. . . . Our life would be a train of smells, and nothing more."—*Jas. Mill.*

[2] "When an individual is deprived of the organs of sight, no power of attention or continued effort of the will, or exercise of the other senses, can make him enjoy the class of sensations which is lost."—*Sir C. Bell.*

[3] "The attentive study of cases in which there is congenital deficiency of one or more senses makes it evident that the mind is utterly incapable of forming any definite ideas in regard to those properties of objects of which these particular senses are adapted to take cognisance."—*Dr. Carpenter.*

[4] "It does not seem at all improbable that there are properties of

sense might probably make revelations to us no less surprising than the sense of sight to one who has been born blind.[1] Further, there are heights and depths in the phenomena of sense of which our present senses cannot take cognisance, but which would be apparent to them were they more acute or powerful. Certain of the lower animals have some at least of the senses in higher perfection than man, if they have not, as some think, senses of which he has no knowledge.[2]

Man, however, is able by means of instruments or appliances of different kinds to greatly extend the power of his senses.[3] Thus by means of the microscope and

natter of which none of our senses can take immediate cognisance, nd which other beings might be formed to perceive in the same nanner as we are sensible to light, sound, &c."—*Dr. Carpenter.* It nay be that "within the field occupied by the visible and ponderble universe, there is existing and moving another element fraught vith another species of life—corporeal, indeed, and various in its rders, but not open to the cognisance of those who are confined to he conditions of animal organisation. . . . Is it to be thought that he eye of man is the measure of the Creator's power?—and has He reated nothing which He has not exposed to our senses? The conrary seems much more than barely possible; ought we not to think almost certain?"—*Isaac Taylor.*

1 "If a new sense or two were added to the present normal umber in man, that which is now the phenomenal world for all of s might, for all we know, burst into something amazingly wider nd different, in consequence of the additional revelations through nese new senses."—*Prof. Masson.*

2 "We find every organ of sense, with the exception of that of ouch, more perfect in brutes than in man. In the eagle and the awk, in the gazelle and in the feline tribe, the perfection of the eye admirable; in the dog, wolf, hyæna, as well as in birds of prey, ne sense of smelling is inconceivably acute; and if we should have ome hesitation in assigning a more exquisite sense of taste to brutes, e cannot doubt the superiority of that of hearing in the inferior nimals."—*Sir C. Bell.*

3 "All observing instruments, all weights, measures, scales, micro eters, verniers, microscopes, thermometers, barometers, &c., are tificial extensions of the senses; and all levers, screws, hammers, edges, wheels, lathes, &c., are artificial extensions of the limbs."— . *Spencer.*

telescope he is able to discern objects invisible to the naked eye; by means of measures and weights he can distinguish differences that are indistinguishable by the eye or hand; and by means of chemical tests he can determine the presence of substances that are indeterminable by taste or smell. These "supplementary senses," as they have been called, have done much to extend our knowledge of nature, and to reveal the presence of objects and forces that were before unknown.[1]

The senses, then, are certain organs of the body by means of which the mind acquires its knowledge of the external world, and of the properties of the various objects which it comprises.[2] They are commonly reckoned five—sight, hearing, touch, taste, and smell; but physiologists generally add a sixth sense, the muscular, which reveals the state of the muscles, and thereby largely contributes to our knowledge of external objects. There are certain other feelings which are by some classed as sensations, having an organ or seat in the body, and consciously affecting the mind. Such are the feelings connected with the stomach or intestinal canal, as hunger, thirst, repletion, indigestion, &c., or such as arise from diseased or abnormal states of particular organs or tissues, as inflammation, cramp, burns, bruises, and the like.[3] These are doubtless sources of

[1] "When to the unaided senses science began to add supplementary senses in the shape of measuring instruments, men began to perceive various phenomena which eyes and fingers could not distinguish. Of known forms of force minuter manifestations became appreciable, and forms of force before unknown were rendered cognisable and measurable."—*H. Spencer.*

[2] "The sensory organs are only instruments of the mind, which has its seat in the brain, and by means of nerves makes use of these instruments to obtain information of external objects."—*Prof. Bernstein.*

"The complicated sensations in the intestinal canal . . . though obscure, and even unknown as individual sensations, often constitute

much pleasure or pain, and thus contribute largely to our mental experience, but they do little in the way of revealing to us the external world, or of adding to our knowledge of things around us. Their office is mainly confined to making known the state and condition of the body itself in order to its maintenance in a sound and healthy condition.[1]

Each of the senses is so formed and constituted as to be susceptible to certain kinds of impressions made upon it from without, and which are conveyed by means of nerves to a central organ, where they become known to the mind. A sensation, then, is a mental impression produced by a material change effected by the action of an external object or stimulus on some part of the body which is sensitive to it, and conveyed to the brain. In other words, it is the mental representation of an external fact by which it is produced.[2] Every normal sensation, therefore, involves: (1) an external agent or stimulus which impresses or acts upon the bodily organ; (2) a bodily organ which receives the impres-

general state of feeling which is sometimes exhilarating and sometimes depressing."—*James Mill.* "The massive influence of the systemic sensations in determining the desires, volitions, and conceptions of mankind, has not been adequately recognised. Yet everyone knows the effect of impure air or a congested liver in swaying the mental mood, and how a heavy meal interferes with muscular and mental exertion."—*G. H. Lewes.*

[1] "The characteristic distinction between these common sensations and the sensations of the senses is that by the latter we gain knowledge of the occurrences and objects which belong to the external world, and that we refer the sensations which they produce to external objects, whilst by the former we only feel conditions of our own body."—*Prof. J. Bernstein.*

[2] "A sensation is a mental representation, the internal sign of an external fact exciting it."—*H. Taine.* It is "the mental impression, feeling, or conscious state resulting from the action of external things on some part of the body called on that account sensitive".—*Prof. Bain.*

sion and carries it inward to the brain; and (3) a mental impression or change corresponding to the physical one. Thus every real sensation corresponds to some external fact, which it represents with more or less approximation to accuracy, and whose internal substitute it is.[1] It is possible to have sensations in the mind which cannot be distinguished from real ones, but which have no external fact corresponding to them—which are caused by no external agent or stimulus; and, on the other hand, all the physical conditions necessary for sensation may be present, but if the mind be otherwise occupied no mental change may take place, in which case there will be no sensation.[2]

Each organ of sense is specially adapted for the reception of its proper stimulus—the eye for light, the ear for sound, the tongue for taste, the nose for smell, the skin for touch, and the muscles for muscular feeling.[3] There is thus no danger of one kind of sensation being confounded with another, nor can one sense by any possibility assume the functions of another. In this way the senses may be said to concentrate the mind in one direction, or upon one object or quality at a time,

[1] "Every normal sensation corresponds to some external fact which it transcribes with greater or less approximation to accuracy, and whose internal substitute it is."—*H. Taine.*

[2] "A state of the sensitive organs, and a corresponding perception by the mind, must concur to produce sensation: either condition may exist alone, but then the phenomenon is not a true sensation."—*Todd and Bowman.*

[3] "Each organ of sense has its own specific irritation by which it is excited. The terminations of the optic nerve in the eye can only be excited by light-waves, not by sound-waves; and the latter can only excite the terminations of the auditory nerve in the ear."—*Prof. Bernstein.* "The nerve of vision is as insensible to touch as the nerve of touch is to light. . . . The beauty and perfection of the system is that each nerve is made susceptible to its peculiar impression only."—*Sir C. Bell.*

ınd thus to secure greater power, definiteness, and)oint.[1]

Whatever may be the nature of the stimulus applied o any of the organs of sense, it will excite only that :ind of sensation for which the organ is adapted. Chus, any stimulus applied to the eye or optic nerve, s a blow or an electric shock, produces a sensation of ight; applied to the ear or auditory nerve, a sensation f sound; and so with the other senses. The optic or uditory nerve may be pricked or cut without giving ise to a feeling of pain, any more than a nerve of touch n being pricked or cut will give rise to a sensation of ght or sound. Thus every sensory organ responds to ll the agents that act upon it only in one and the same ay.

In each organ of sense we have three distinct parts:) an external or outer terminal portion which is speally fitted to receive and take up its appropriate npressions; (2) a sensory nerve which serves to onvey the impression inward; and (3) a central teruinal portion in the encephalon for receiving it and esenting it to the mind. The outer terminal portion, what is commonly known as the organ of sense, is ecially adapted to receive and take in the impressions ade upon it from without. In some we also find hat are known as "multipliers of disturbance," or

[1] "The organs of sense are particular adjustments of nervous senility, intended to concentrate the mind at different times upon igle properties of the external world, with a view to the better curing of definite purposes."—*Isaac Taylor.* "The organs of sense y be compared to so many instruments which the philosopher plies to distinguish the several qualities of the body which he vestigates. The different properties of that body are not comnicable through any one instrument; and so in the use of the ises each organ is provided for receiving a particular influence, l no other."—*Sir C. Bell.*

contrivances for rendering the impressions more intense than they otherwise would be.[1] Without the outer organ of sense we could have no sensation properly so called. The optic nerve itself apart from the retinal expansion is as insensible to light as a motor nerve is. Irritation of the optic nerve "may certainly occasion luminous patches, globes of fire, and coloured figures in the retina," but not complex forms such as houses, men, trees; so in hearing irritation of the auditory nerve "may determine buzzings and noises loud or otherwise in the ear but not actual words or tunes".—*Dr. Griesinger*. The sensory nerves serve simply to transmit the impression from the outer organ to the central structure, where it impresses the mind and becomes a fact of consciousness. This central portion is the most important part of the organ. It is upon its individual centre that the special character of each class of sensations depends.[2]

In inflammation or other abnormal states of a centre, sensations are frequently felt without any external cause, and without the external organ or nerve being affected

[1] "The extremities of the nerve fibres are so placed as to be most easily disturbed, and we generally also find what may be called multipliers of disturbances, which serve to concentrate upon the ends of nerves the actions of external agents. Thus, where the sense of touch is most acute, there are certain small dense bodies, named *corpuscula tactus*, round each of which a nerve fibre ramifies so as to receive a greater pressure when touched. In like manner there are certain otolites and minute rods or fibres immersed in a liquid in the inner ear, serving to intensify the less sensible vibrations communicated to this liquid."—*H. Spencer*.

[2] "The immediate condition of the sensation is found in the nervous centres, where there is produced a molecular movement of unknown nature, without which the sensation cannot arise, and which is of itself sufficient to give rise to it. . . . Many sensations arise in us without the intervention of the nerves, and by the simple excitation of the nervous centres. Such are hallucinations strictly so called."—*H. Taine*.

from without Ringing in the ears, flashing of light before the eyes, nauseous tastes or disagreeable odours, are familiar instances of this. In all such cases, however, the centre can only recall previous impressions. If it has not previously been in a state of activity, no sensation can possibly be felt. No condition of the centre itself will ever give rise to sensations unless it has first been stimulated from without.

In every act of sensation the mind is the most important factor. It is this which takes up, fashions, and interprets the impressed sensation.[1] A stimulus may affect a sensory organ, may produce a disturbance in the nerve, and there is every reason to believe may even agitate the nervous centre, but if the mind is otherwise occupied it will not be perceived.[2] Sometimes the idea in the mind masters the outward sensation, and men fancy that they perceive things which have no objective existence, or they seem to them very different from what they are. To the perturbed or terrified mind the simplest forms sometimes present the most frightful aspects, and the mesmerised subject may be induced to believe that the water in his mouth is wine or vinegar.[3]

[1] "It is not the stimulus which is the object felt, it is the change in consciousness."—*G. H. Lewes.* "What we term the perception of an individual, as a given tree, is not simply a sense-impression of the moment, it is an aggregation of many generalised impressions." —*D. Stewart.*

[2] "Every minute we experience twenty sensations of heat, cold, pressure, contact, muscular contraction ; slight sensations like these are being incessantly produced in all parts of our bodies ; in addition to this, sounds, murmurings, and hummings are constantly going on in our ears ; a number of little sensations of smell and taste arise in our noses and throats ; but we are otherwise engaged—we are thinking, meditating, talking, reading—and during all this time we neglect other things."—*H. Taine.*

[3] "Children, and even grown men, have fallen insensible before a

Whatever acts upon an organ of sense does so in the form of motion. Nothing can act upon the senses or be taken up by them unless it present itself to them in the form of motion.[1] Light and colour result from the undulations of an extremely delicate aerial fluid which strikes the eye; all sonorous bodies are bodies in motion, the motion being communicated to the surrounding atmosphere and so entering the ear; taste and smell also result from motions that necessarily take place before objects of these classes can be perceived. Touch is also a manifest instance of motion, as all touch implies motion. Thus touch of one kind or another is involved in every act of sensation; and

figure, or even a cloth, which they have believed to be a ghost. On recovering, they have asserted that they saw flaming eyes, open jaws, &c."—*H. Taine.*

[1] "The only way in which the external world affects the nervous system is by means of motion. Light is motion, sound motion, heat motion, touch motion, taste and smell all motion. The world is known to sense simply by virtue of, and in relation to, the motions of its particles; these motions are appreciated and continued by the nervous system, and by it are brought at length to the mind's perception. When the mind reacts in its turn upon the world, it does so wholly through the nerves of motion. The last material action we can trace in every process of sensation previous to its entering the abode of consciousness is motion; the first reaction we see as it emerges from the abode of consciousness back into time and space again is motion."—*J. D. Morell.* "Whatever may be the structure of the nerves and nervous centres whose action excites a sensation, however various this structure may be supposed, that which is transmitted from one end of the nerve to the other up to the ultimate nervous centre is never more than a molecular displacement more or less rapid, extensive, and complex. . . . So that the different nervous actions which excite different sensations can only be conceived as systems of movements."—*H. Taine.* "How exceedingly different to the *eye of the mind*, as we may say, are our ideas of sensible things from anything that could have been conjectured concerning their effect upon us—as the ideas of sound from the tremulous motion of the particles of the air, and much more the ideas of the different colours from the impulse of the rays of light of different degrees of refrangibility."—*Dr. Priestley.*

modern science has verified the ancient doctrine of Democritus, that all the senses are modifications of the sense of touch.[1]

The motions which give rise to sensations only affect the mind within certain limits. A certain velocity is necessary in order to their being perceived, and beyond a certain velocity they cease to affect the mind.[2] This has been illustrated by supposing a rod revolving on one end any number of times a second in a dark room. At first when it attains about 16 or 20 revolutions a second, a deep growling sound reaches the ear, becoming less and less grave and more and more acute with the increase of velocity, till it reaches a pitch of shrillness hardly to be borne when the speed is reckoned by tens of thousands. At length when it arrives at about 40,000 revolutions a second the shrillness passes into silence—a silence never again to be broken. But let it attain some millions of revolutions a second, and faint rays of heat will be given out, becoming more and more intense as the rate of movement increases. When it has reached some four hundred billions of times a second a dim red light is seen, and now as the rate still mounts up the heat in its turn dies away like the

[1] "Every impression on the senses can be resolved finally into an impression of contact or touch; so that touch is the fundamental sense, and all the organs of the senses are but very delicate instruments of touch."—*Dr. Laycock.* "As Democritus long ago shrewdly observed, all the senses are only modifications of touch."—*Sir W. Hamilton.* "Not only do the conclusions of physicists support this doctrine which Democritus taught, but the conclusions of biologists do the like. . . . A contact of the undulating medium with an adapted part of the surface is the prerequisite to any impression."—*H. Spencer.*

[2] "A stimulation must reach a certain intensity before it is a feeling . . . but beyond a certain limit increase of stimulation diminishes, and finally arrests the activity. Duration of stimulation is equivalent to increase. . . . Excess of light is blinding, excess of sound deafening."—*G. H. Lewes.*

sound, never to return, and the red light gradually passes into a yellow, a green, a blue, and last of all a violet, to be followed by darkness never again to be broken when the velocity has reached about eight hundred billions a second. Beyond this, however much the velocity may be increased, it will never again become manifest to any of the senses.

We cannot imagine that a single stimulus acting on an organ of sense could at once raise the vibratory motion from zero to these high rates. We must suppose the various nerves to be incessantly vibrating with more or less rapidity, and ready to be set in more active agitation at a moment's notice by the vibratory action of external objects.[1] Hence it is when the vibrations within the body are accelerated by vibrations from without, that we have sensation.

All our sensations are compounds of movements, which in order to be perceived require to be grouped together so as to acquire a certain bulk, and to occupy a certain time. Every object perceptible by any of the senses is made up of innumerable particles which are imperceptible.[2] Thus the distant murmur of the sea is

[1] "The fact that a stimulation must reach a certain intensity before it is a feeling, and that henceforth this feeling increases in a constant ratio with the increase of the stimulus, to vanish abruptly when a certain limit is reached, proves that there must be molecular movements in the tissue which are not grouped into processes, and this both before a sensation emerges and after it has vanished. . . . Undulations can be shown really to exist both before they have acquired the quantitative rapidity necessary for the qualitative effect of light and after this quantity has been surpassed. There is no light, no luminous effect, before the undulations have reached some four hundred billions in a second, nor after they have passed some eight hundred billions: these are the luminous limits; on either side of these limits the retina refuses to respond by the feeling known as luminous quality."—*G. H. Lewes.*

[2] "The elementary sensations directly making up our ordinary sensations are themselves compounded of sensations of less intensity

made up of the noise of many waves. While the sound of any individual wave might be inaudible, yet each one contributes its quota to make the whole heard. Thus sensation only takes place under certain conditions of mass, intensity, and duration.[1]

The motion which acts upon the external organ is communicated to the nerve, and through it is conveyed to the nerve centre. The sensory nerves, like all nerves, are characterised by the extreme mobility of their contents, or their susceptibility of molecular change, and are thus eminently fitted for conveying the impressions they receive. That which is transmitted is in every case a disturbance or displacement of the nerve molecules which is set up or originated in the external organ, and conveyed to the central structure, where it is taken up by the mind.

Thus all that is transmitted from an organ of sense to the brain is a particular kind of motion. It is the mind that imparts to each of these its particular interpretation. "Our sensations," says Helmholtz, "are for us only symbols of the objects of the external world,

and duration, and so on. Thus there is going on within us a subterranean process of infinite extent; its products alone are known to us, and are only known to us in the mass. As to elements and their elements consciousness does not attain to them . . . they are to sensations what secondary molecules and primitive molecules are to bodies. . . . We get a glance here at the obscure and infinite world extending beneath our distinct sensations. These are compounds and wholes. For their elements to be perceptible to consciousness it is necessary for them to be added together, and so to acquire a certain bulk and to occupy a certain time; if the group does not attain this bulk, and does not last this time, we observe no change in our state. Nevertheless, though it escapes us there is one."—*H. Taine.*

[1] "The sensory organ needs to be impressed with a certain energy and for a certain time; neither too small an energy nor too great an energy, otherwise there is not the reaction which is specifically a sensation."—*G. H. Lewes.*

and correspond to them only in some such way as written characters or articulate words do to the things they denote."[1]

Nerve-force has much in common with electricity, and it is not improbable that it is a particular form of this power; but while the electric current passes along the wire at the rate of about 288,000 miles in a second, nerve-force traverses a nerve at the rate of only about 100 to 130 feet in the same space of time.[2] Hence its progress has been compared rather to ignition passing along a train of gunpowder; and it has this too in common with the latter, that every act of stimulation is attended with waste of nerve substance, which requires to be constantly renewed, whereas no such waste takes place in the electric wire. Unlike the electric current, too, nerve-force appears to gather strength as it passes along the nerve, becoming stronger the longer its course. Further, nerve-force does not act continuously but intermittingly, in waves or impulses.

The senses directly or indirectly furnish all the materials of thought and of knowledge, for there is nothing in the mind that has not entered it through the senses. They also supply the stimulus necessary to develop every inborn faculty, for without their aid every power

[1] "For a sign it is sufficient that it become apparent as often as the occurrence to be depicted makes its appearance, the conformity between them being restricted to their presenting themselves simultaneously; and the correspondence existing between our sensations and the objects producing them is precisely of this kind."—*H. Helmholtz.*

[2] "The nerve current travels slowly compared with the velocity of electricity or of light. In the motor nerves of the frog the velocity is about 87 feet per second, and in man and warm-blooded animals somewhat faster, 115 to 130 feet per second. . . . The remarkable point is that the transmission of the nerve current is slow."—*Prof. M'Kendrick.*

of the mind would remain for ever dormant.[1] Without their aid, too, without their guidance and direction, voluntary action would be impossible.[2] We can only will to do a thing by knowing beforehand what it is and how it is to be effected, and this knowledge comes to us solely through the senses. Hence, the more we exercise and train the senses, the more do we develop and strengthen our several mental powers, do we store

[1] "Apprehension by the senses supplies directly or indirectly the material of all human knowledge, or at least the stimulus necessary to develop every inborn faculty of the mind."—*H. Helmholtz.* "Sensibility is the indispensable condition of the development of all our faculties, not only of the faculties that evidently pertain to sensibility, but of those that seem to be most remote from it."—*V. Cousin.* "It may be affirmed with certainty that no mental action can be originally excited save by the stimulus of sensations."—*Dr. Carpenter.* "We doubt whether the body would ever be exercised under the influence of reason alone, and if it were not first directed by sensibilities which are innate or instinctive."—*Sir C. Bell.* "The nerve cells of our cerebral hemispheres are so completely dependent, for that excitation of force which constitutes intellectual action, upon the stimuli conveyed to them through the sensory ganglia from the organs of sense, as are those of our spinal cord upon the stimuli conveyed to them either from the superior nerve centres or from the peripheral irritation of an afferent nerve."—*Dr. Child.* "It is almost a truism to say that in proportion to the numerousness of the objects that can be distinguished, and in proportion to the variety of co-existences and sequences that can be severally responded to, must be the number and rapidity and heterogeneity of the changes going on within the organism—must be the amount of vitality."—*H. Spencer.* "We are most fully conscious when we are most receptive of external impressions, and we lapse into a completely or partially unconscious condition when the advent of such impressions is for a time prevented, or when we are intensely absorbed in some train of thought, that is, when the activity of other portions of the cerebral hemispheres in some way dwarfs or eclipses that of the sensorial regions proper."—*Dr. Bastian.*

[2] "No voluntary action can be performed without the assistance of a guiding sensation, as was first prominently stated by Sir C. Bell. When we are about to make a muscular effort, the amount of force which we put forth is governed by the mental conception of that which will be required as indicated by the experience of former sensations."—*Dr. Carpenter.*

the mind with materials of thought, and do we act with efficiency and skill in whatever lies before us.

The senses have much more to do with the memory than is commonly supposed. In proportion as we educate and train the senses do we improve and enrich the memory, and the principles that guide us in the one case are the same as those we should follow in the other. The importance of the cultivation of the senses to memory will be still further seen if it be the case, as we believe it to be, that they are not only concerned in the acquisition of our knowledge, but concerned also in the remembrance of it—that we cannot remember a thing well, cannot imagine it, without the senses, the means by which it originally entered the mind being again called into play. The senses would then be seen to be necessary not only to the acquisition of our knowledge, but necessary also to the retention and reproduction of it.[1] On the other hand, without memory, without the power of retaining and recalling past impressions, sense-cultivation would be impossible.

[1] "Suppose that once, and only once, I smelled a tube rose in a certain room, where it grew in a pot, and gave a very grateful perfume. Next day I relate what I saw and smelled. When I attend as carefully as I can to what passes in my mind in this case, it appears evident that the very thing I saw yesterday, and the fragrance I smelled, are now the immediate objects of my mind when I remember it. . . . Upon the strictest attention, memory appears to me to have *things that are past*, and not present ideas, for its object." —*Dr. T. Reid.* "If I now think of the tangible idea of a cube—that is, if I think of its figure and of the solidity of every part of that figure—I must conceive myself as passing my fingers over it, and seem in some measure to feel the idea as I formerly did the impression, as the ends of them."—*Dr. E. Darwin.* "The chess-player who plays blindfolded, the painter who copies an absent model, the musician who hears a score when he looks over a sheet of music . . . experience the same emotions as if the chess-board, the model, the symphony, were actually experienced by their senses. It provokes the same instinctive movements, and the same associated sensations." —*H. Taine.*

That the senses have anything to do with the remem-rance of past impressions is, however, contrary to the pinion almost universally received among physiolo-ists, who regard the brain as the sole seat of the nemory. They are shut up to this view, because it is egarded as an established doctrine in physiology that ach class of nerves convey impressions only in one irection—the afferent or sensory nerves to the brain, nd the efferent or motor nerves from the brain—the eat of consciousness. According to this, every sensa-ion we experience is conveyed to the brain, and is here treasured up for the after use of the memory.

It was formerly believed that there existed a differ-nce in the nature or structure of the two kinds of bres to account for their different modes of action. 'his, however, is found not to be the case, for the two lasses of fibres are exactly alike, and are each capable f transmitting impressions in either direction.[1] A ensory and a motor nerve may be joined, and when ie union is complete excitation of the sensory will be ansmitted to the motor fibres.[2] If a nerve be irritated

[1] . . . "*A priori* it is irrational to assert that nerves fundamentally ike in composition and structure are unlike in properties. . . . here is consequently no reason for asserting that because the usual rection is centripetal in a sensory nerve and centrifugal in a motor rve, each nerve is incapable of transmitting excitations in both rections . . . There is no fundamental distinction between the two rves; both are sensory and both are motor, but they are so in fferent degrees. They are, strictly speaking, distinguishable as uscle-nerves and skin-nerves (he is here speaking only of one nd of sensory nerves), the muscle-nerves being the channels for uscular sensations and muscular movements; the skin-nerves being e channels for skin-sensations and skin-movements."—*G. H. Lewes.*

[2] "It is proved that the end of a sensory nerve may be united ith the end of a motor nerve, and when the union is complete citation of the sensory may be transmitted to the motor fibres, and e reverse."—*Dr Maudsley.* "If we engraft the end of a rat's tail to the skin of its back, and then when the grafting process is com-eted cut the basilary portion of the tail about a centimetre from

in any part of its length, say about the middle, th excitation is simultaneously transmitted towards eac end.[1] Sensory fibres convey impressions inward, becaus they are connected with sensorial parts of the brain, an upon the nature of the part depends the character c the sensation,—whether it be a sight, a sound, a touch a taste, or a smell; and motor fibres convey motoria stimuli outward because they are connected with moto organs. "If it were possible," says Dr. Bernstein "we might place any motor nerve between the eye an the brain, and the perception of light would not b destroyed in the least."[2]

The unsatisfactory nature of the received opinion i especially apparent when we consider the efferen nerves by means of which muscular movements ar effected. There are few or no afferent nerves connecte with the muscles, and yet the mind is constantly awar of their condition, and of the movements that may b taking place in them. How, then, is this knowledg conveyed to the brain? Some have attempted t account for it by supposing that the afferent nerve

the root; after some months, if the grafted tail, be pinched th animal feels it and turns round to bite. The irritation of the nerv which before the operation acted in a centripetal direction, now act in a centrifugal one."—*H. Taine.*

[1] "It would appear from experimental evidence that when a nerv fibre is irritated, say about the middle of its length, a change i simultaneously propagated towards each end."—*Prof. M'Kendrick* "Every excitation applied to any part of the length of a nervou fibre is immediately and simultaneously transmitted in two direc tions—centripetal and centrifugal."—*H. Taine.*

[2] "Very lately the French physiologists Philippeau and Vulpian after dividing the motor and sensitive nerves of the tongue, succeede in getting the upper half of the sensitive nerve to unite with th lower half of the motor. After the wound had healed they foun that irritation of the upper half, which in normal conditions woul have been felt as a sensation, now excited the motor branches below and thus caused the muscles of the tongue to move."—*H. Helmholtz.*

;hich proceed to the skin covering the respective ıuscles convey the information.[1] The simple and ufficient answer to this is that the sensibility of the kin may be entirely lost or destroyed, and the sense of ıuscular movement still remain. "I have seen," says)r. Brown-Séquard, "a child completely deprived of utaneous sensibility (unable to feel contact, pressure, ricking, pinching, cold, or heat), yet able to walk well ithout looking at its feet, and undoubtedly owing this ower to the persistence of guiding sensations in the ıuscles." Others hold that the muscular feeling is de- ved from the outgoing current;[2] but, says Dr. Bastian, The impressions derived from muscular movements are either anterior to, nor concomitants of, outgoing cur- ents, but strictly sequential to the passage of such ırrents,—that they are in fact due to ingoing currents erived from the moving parts themselves".

There is only one way in which this can be explained— amely, that the nerves which convey the impulse from ıe brain to the muscles serve also to carry back an apression from the nerves to the brain. Thus while ı impulse proceeds from the brain to the muscles ong the efferent nerves, an impression must also be

[1] "In his admirable treatise on *Physiology*, Schiff maintains that l the phenomena attributed to the muscular sense are due to the ldings and stretchings of the skin when the muscles contract."— *H. Lewes.* "The muscles themselves receive no true sensitive rves, but we obtain knowledge of their action through the change ıich, in motion, they occasion in the sensitive skin."—*Prof. van der ılk.*

[2] "As the nerves supplied to the muscles are principally motor rves, by which the muscular movements are stimulated from the ain and nerve centres, our safest assumption is that the sensibility companying muscular movement coincides with the *outgoing* stream nervous energy. . . . We are bound to presume that this (sensi- ity) is the concomitant of the outgoing current by which the ıscles are stimulated to act."—*Prof. Bain.*

conveyed from the muscles to the brain along the san nerves; and if in the efferent, so also in the afferei nerves there must be a double motion, the one co: veying an impression from the organ of sense to tl brain, the other proceeding from the brain to the orga of sense. The impulse which originates in the orga of sense and passes inward to the brain does not term nate there, but gives rise to secondary movemen which proceed from the brain to the organ of sens If we stand by the seashore observing the waves as the come in, we see that each as it reaches its terminatic on the beach gives rise to a number of wavelets, whic pass outward in the opposite direction. This is wh we believe takes place in the nerves,—that senso nerves, while primarily afferent, are secondarily efferen and motor nerves, while primarily efferent, are secon arily afferent.

We find evidence in support of this view in the di tinction that is drawn by philosophers between sens tion and perception.[2] In sensation, strictly so calle

[1] "When a nerve acts upon a muscle, the muscle reacts on tl nerve; and when a nerve acts upon a centre, the centre reacts c the nerve. The agitation of the central tissue cannot leave the ner which blends with it unaffected; the agitation of the muscular tiss must also by a reversal of the current affect its nerve."—*G. H. Lew*

[2] "When I smell a rose there is in this operation both sensatic and perception. The agreeable odour I feel, considered by its without relation to any external object, is merely a sensation. affects the mind in a certain way; and this affection of the min may be conceived without a thought of the rose or any other objec . . . In sensation there is no object distinct from that act of tl mind by which it is felt. . . . Perception has always an extern object, and the object of my perception in this case is that qualit in the rose which I discern by the sense of smell."—*Dr. T. Rei* "For the production of a sensation a conscious state of mind is a that is required; whilst, on the other hand, for the exercise of th perceptive power, a certain degree of attention is requisite; or, i other words, the mind must be directed towards the sensation."—*D Carpenter.*

a wave of influence passes inward from the organ of sense to the brain, and occasions a feeling; whereas in perception the mind passes out towards something external to itself, and obtains a knowledge of it. In sensation the mind is simply conscious of a subjective feeling; "while in perception," says Dr. Ueberweg, "it goes out upon something that has been perceived, nd which, therefore, whether it belongs to the outer vorld or to the subject itself, opposes itself to the act f perception as something different".[1] In sensation he mind is merely passive, whereas in perception it is ctive. "Sensation taken in itself," says Dr. T. Reid, implies neither the conception nor belief of any xternal object. . . . Perception implies an immediate onviction and belief of something external,—something ifferent both from the mind that perceives and from ne act of perception."

Children at first have sensations without perceptions; nat is, they cannot localise their sensations or refer nem to anything out of themselves. Hence, while ney feel the pain occasioned by the surgeon's lancet, ney do not know its seat or the cause from which it prings, and so their efforts are not directed to its moval.[2] In later life we never have a sensation withut a perception, without referring it to something cternal to the mind.[3] If I prick my finger I am at

[1] "A cognition is objective; that is, our consciousness is then ative to something different from the present state of the mind elf. A feeling, on the contrary, is subjective; that is, our conousness is exclusively limited to the pleasure or pain experienced the thinking subject."—*Sir W. Hamilton.*

[2] "Every surgeon knows that the young infant may be allowed have his hands free when operated on, because it cannot with its nds interfere with the knife, not as yet knowing where the seat of in is."—*G. H. Lewes.*

[3] "We never now experience a sensation without assigning it a ice."—*H. Taine.*

first only sensible of the pain, but immediately afte wards I distinguish it as a particular kind of pai located in a particular place, and caused by a particul instrument.

The importance of this doctrine, of each class nerves being capable of conveying impressions in bot directions, is, that it enables us to explain in what wa the mind proceeds from the brain to the organs sense or the muscles in recalling past sensations movements. Unless the same parts are concerned i the recalled sensation as were active in the origina we cannot imagine that they would so closely resemb each other. That the retina is concerned in the recal ing of an object of sight appears to be proved by th fact already mentioned (p. 33), that when we thin intently upon a particular colour, with the eyes close the retina becomes exhausted, as regards that colou in the same way as if it were actually contemplating i and the object assumes the appearance of the compl mentary colour.[1] What holds true in regard to sig is doubtless true also in regard to the other sense And as with the senses so with the muscles. The grow, and develop, and gather strength in the directio in which they are exercised, so that what was at fir difficult and disagreeable becomes by degrees easy an natural. This, doubtless, depends upon chang wrought in the muscles themselves, and not on th nerves or nerve centres, which, as we have seen (p. 84 simply supply the stimulus by which the energies store

[1] "Newton, Johannes Müller, and Hermann Meyer have record how, after intently thinking with closed eyes of some particul colour, the retina becomes as exhausted by the image as if it h been exposed to an objective stimulus of colour, so that on openi the eyes ocular spectra intercept the objective stimulus."—*G. Lewes.*

p in the muscles are set in motion.[1] It is the muscles ıen, rather than the nerve centres, that form the seat f the memory of past muscular activities.

In sensation the movement originates in the organ of ense, and is conveyed to the brain; while in motion it iginates in the brain and passes onward to the motor gans. In recollection the reverse of this takes place. Then we recall a past sensation the movement origiates in the brain, and is conveyed along the afferent erves to the organ of sense; and in recalling a motion eviously made, the mind refers to the muscles and stimulus received from them is conveyed along e efferent nerves to the brain, like a tactile stimulus ong a nerve of touch. That the brain should be le to originate movement in an afferent nerve is not ore strange than that it should originate it in an ferent nerve. In the one case, as in the other, the ind originates the movement that takes place.

In our view, then, we cannot remember a thing perctly by means of the brain alone, but must also call to exercise other parts of the system, especially the gans of sense, or the muscles. Defects of memory e, we believe, mainly owing to this, that recollection made too much an intellectual operation depending ı the brain, without any organ of sense or other part

[1] "A daily experience teaches us that a muscle becomes the onger the more we use it. The muscular fibre, which in the first stance may have answered but feebly to the stimulus conducted to by the motor nerve, does so with the greater energy the more often is stimulated, provided, of course, that reasonable times are allowed repose. After each individual action it becomes more capable, ore disposed towards the same kind of work, and has a greater titude for repetition of the same organic processes. It gains also in ight, for it assimilates more matter than when constantly at rest. . . And what is known thus certainly from muscle substance holds od, with greater or less plainness, for all our organs."—*Dr. E. ring.*

being brought into operation. When the brain alone is called into activity, then is the memory of the fact imperfect, and this is the character of the great majority of our recollections. We are content with only a partial recall, in which none of the senses or any other part, but only the brain, is concerned. When this is indulged in to any great extent, not only is the memory weakened, but mind-wandering is induced, in which the individual is unable to concentrate his attention on one subject for any length of time, but allows it to wander away in other directions on the least suggestion. The cure for this mind-wandering is the training of the mind to recall things, not partially, but fully and completely, by bringing into activity not the brain alone, but likewise the appropriate organs of sense, or the muscles. When this is the case, the recalled sensations or movements are represented to the mind in their most complete form, the form in which they take the strongest hold on the mind, and which it will not let go on every slight occasion.

It naturally follows from this, that when an organ of sense is totally destroyed, the memory of the sensations that were received through that sense will be impaired, and in time probably lost. This, then, appears to be the case. Sir W. Hamilton says: "There are many cases recorded by medical men of persons losing their sight who have also lost the faculty of representing the images of visible objects. They no longer call up such objects by reminiscence; they no longer dream of them. . . . Similar cases are recorded in regard to the deaf." Dr. E. Darwin mentions a gentleman he knew, about 60 years of age, and who had been totally deaf for nearly 30 years, who assured him that in his dreams he always imagined that people conversed with him by signs or

vriting, and never that he heard anyone speak to him. n blindness, he says, "it rarely happens that the im-nediate organ of vision is perfectly destroyed. The nost frequent causes of blindness are occasioned by efects of the external organ, as in cataracts and ob-uscations of the cornea. But I have had the opportunity f conversing with two men who had been some years lind; one of them had a complete gutta serena, and ne other had lost the whole substance of his eyes. 'hey both told me that they do not remember to have ver dreamt of visible objects since the total loss of neir sight." The brain may probably be able to recall ensations connected with an organ of sense after the rgan itself has been destroyed, in such a way that to ne superficial observation of the person himself there nay appear to be little or no difference, and yet in eality the difference may be very great.

But not only is the memory not alone confined to ne brain, but there is every reason to believe that the nind itself is not confined to that organ, but is diffused nroughout the system at least as far as the nerves xtend, and they stretch to all parts of the body.[1] There is no good ground to suppose," says Sir W.

[1] "The brain is universally held to be the organ of the mind," t "I do not agree in this opinion. . . . The brain is only one gan of the mind, and not by any means the exclusive centre of nsciousness."—*G. H. Lewes.* "The facts of physiology rightly terpreted lead irresistibly to the conclusion that sensation is not nfined to the brain, but is spread over the whole sensory system. herever there is a sensory nerve there there may be a sensation." *Dr. J. Cunningham.* "We do not assert that the mental principle s its seat in the brain alone. It is possible for the mind to act d receive impressions by means of one organ of a determinate ucture, and yet be present generally throughout the body. . . . e mental principle or cause of the mental phenomena, viz., the ception of ideas, thought, &c., cannot be confined to the brain," t "exists, though in a latent state, in every part of the organism". -*Dr. J. Müller.*

Hamilton, "that the mind is situate solely in th brain, or exclusively in any one part of the body. . . Even if we admit that the nervous system is the par to which it is proximately united, still the nervous sys tem is itself universally ramified throughout the body and we have no more right to deny that the mind feel at the finger-points, as consciousness assures us, thai to assert that it thinks exclusively in the brain."[1] " for one," says Prof. Cleland, "most strenuously deny that the cerebral hemispheres are "the only parts con nected with the mind. . . . I do not think that sensatio can be accounted for without believing that conscious ness works in connection with as much of the nervou system as is at any one time united to the brain b nerve channels in an active state." "This view," say Prof. M'Kendrick, "is quite consistent with all th facts of nervous physiology, and presents fewer diffi culties than the one generally held, which drives con sciousness into the recesses of the nerve cells in th cortex of the cerebral hemispheres. It appears to kee clear of the prevailing error in the philosophy of moder physiology, that of regarding the body, and even th nervous system, as a vast series of almost independen organs, losing sight of the community of function an interdependence of parts, characteristic of the body c one of the higher animals."

It would therefore seem that the organ of the min

[1] "The mind is not, as we suppose, the prisoner of the attic storey but is the occupant at large of the entire animal organisation, actin in each part of the structure according to the purpose of each: in th arm and leg willing the limb hither and thither by its inheren power over matter, in the skin, the eye, the ear, the tongue, th nasal membrane receiving immediately the impressions of externa objects by its inherent susceptibility of the properties of matter, an let it be granted, within the cranium carrying on the processes o thought."—*Isaac Taylor.*

s not the brain alone, but the whole nervous system. 'In place of holding," says Sir W. Hamilton, "that he mind is connected with the body only at the entral extremity of the nervous system, it is more imple and philosophical to suppose that it is united with he nervous system in its whole extent." The whole ervous system is, in fact, to be regarded as forming ne organ, the ganglia and nerves being, in fact, but ontinuations of the brain, and the mind being present 1 all their parts.[1] The axis-cylinder of the nerve fibre nd the protoplasmic matter of the nerve cell are not only irectly continuous, but are constitutionally the same.[2] Physiologists are shut up to the doctrine that the nind has its seat only in the brain so long as they hold

[1] "Virtually the brain is prolonged by these communicating fibrils the eye, the ear, the nose, the mouth, the skin."—*Edinburgh Review.*

[2] "Anatomists are now tolerably unanimous as to the axis-cylinder ing identical with the protoplasmic cell substance."—*G. H. Lewes.* The nerve substance, in spite of its thousandfold subdivision as lls and fibres, forms nevertheless a united whole which is present rectly in all organs."—*Dr. E. Hering.* The brain and nerves aken together form what is truly one complicated sensorial organ the organ of all our sensations according to the different states in hich the organ exists, or the different parts of it which are chiefly ected".—*Dr. Thos. Brown.* According to Mr. H. Spencer, "the rvous system consists of one kind of matter under different forms d conditions. In the grey tissue this matter exists in masses conining corpuscles which are soft, and have granules dispersed rough them, and which, besides being thus unstably composed, e placed so as to be liable to disturbance in the greatest possible gree. In the white tissue this matter is collected together in tremely slender threads, that are denser, that are uniform in texre, and that are shielded in an unusual manner from disturbing rces, except at their two extremities." The functions discharged the two substances are not absolutely distinct. "On the one nd, the vesicular substance, having for its chief office to give out lecular motion when disturbed, has also a considerable power of nveying or conducting molecular motion." Conversely, "the tter forming the 'axis-cylinder,' or essential nerve thread, has a tain power of simultaneously giving out molecular motion, so aring the property of the vesicular matter".—*Herbert Spencer.*

the opinion that sensory nerves are capable of con veying impressions only in one direction. The sensa tion, they say, passes to the brain, and there it stops No impulse from the brain can pass along a sensor nerve, nor can the mind itself by any possibility travers the nerve to the organ of sense. If I touch the tabl with my hand consciousness tells me that I have th feeling in my hand, but the physiologist says that I ca only have it in the brain, because sensory nerves ca convey impressions only to the brain. But if, as w have endeavoured to show, sensory nerves convey im pressions in both directions, then consciousness ma after all be right, and a stimulus pass outward fron the brain to the hand to constitute an act of perception "We have no reason whatever," says Sir W. Hamilton "to doubt the report of consciousness, that we actuall perceive at the external point of sensation, and that w perceive the external reality." "We are in the habi of saying," remarks Dr. Abercrombie, "that the im pressions are conveyed to the brain, but even in thi we may probably advance a step beyond what is war ranted. We know that the nerves derive their influenc from the connection with the brain, or as forming alon with it one great medium of sensation; but we do no know whether impressions made upon the nervou fabric connected with the organs of sense are conveye to the brain, or whether the mind perceives them directly as they are made upon the organs of sense." The view advanced by Prof. Cleland is, "that when a irritation is applied to a nerve extremity in a finger o elsewhere, the impression (or rather impressed condi tion) travels, as is generally understood, to the brain but exists for at least a moment along the whole lengt of the nerve, and that as soon as there is continuity o

he impressed condition from finger to brain the conciousness is in connection with the nerve, and is lirectly aware of the irritation at the nerve extremity". Chis goes to support the notion that in sensation conciousness is in direct connection with the organ of ense, and that what we feel is felt there, and not nerely in the brain; but it gives no support to that for vhich we contend, that in recalling a past sensation he mind refers to the special organ of sense which was riginally concerned in it, though the two are nearly onnected. Only the hypothesis of the existence of wo kinds of motion in the nerves will meet and exlain both cases.

The great use of the senses is to impart to us a nowledge of the world in which we live and act, in rder that we may act wisely and live well in all the elations of life.[1] The fuller and more accurate our nowledge of the world around us, and of the laws in ccordance with which all its operations are carried on, he more will our actions be characterised by wisdom nd prudence. Accuracy and keenness of observation re essential to success in life.[2] Men must observe ccurately before they can reason correctly. Most of ne errors that prevail in the world spring not so much om illogical reasoning as from inaccurate observation.[3]

[1] "The senses supply the basis for the whole action of man upon ie outer world."—*H. Helmholtz.* "What is the part played by nowledge? Its highest no less than its lowest aim is guidance in tion."—*G. H. Lewes.*

[2] "One of the principal forms of human intelligence consists of permanent hold of the external world as it strikes the senses."—*rof. Bain.* This "gives us a sort of foresight which enables us to gulate our actions for the benefit of life, and without this we should eternally at a loss: we should not know how to act anything at might procure us the least pleasure or remove the least pain of nse".—*Bishop Berkeley.*

[3] "The errors in the world come less from illogical reasoning than

Further, the laws of our mental life are such that it is constantly necessary to bring our ideal knowledge to the touchstone of experience and fact. The mind is ever prone to form ideas and construct theories of things. This is its nature and office, but it is to be borne in mind that these ideas and theories are only of use to us as they correspond with and represent external realities. Without this, in place of leading us to right action, they may lead us into the greatest blunders and land us in inextricable confusion. It is therefore of the greatest importance ever to maintain the closest and most intimate connection between the two—the real and the ideal. The real serves to give clearness, fixedness, and permanence to the ideal; the ideal to mould, fashion, guide, direct, arrange the real.

Formerly men were wont to rear huge scientific structures upon a few loosely observed facts; but now, perhaps one of the most marked and promising features of the present day is the attempt in all cases to establish a wide basis of facts, and from these to rigidly deduce the principles they embody or the truths they contain.

from inaccurate observation and careless hearing. Most men see as much with their preoccupied imagination as with their eyes, and do not know how to separate their own fancies, or their erroneous interpretation of a fact, from the observed fact itself."—*Dr. Thos. Hill.* "Nothing, in fact, is more difficult than to have a clear and precise appreciation of real things. The minute care taken by physicists and chemists, and the infinite precautions with which they surround themselves, in order to appreciate simple physical phenomena, show us how frequent are the causes of error, and how liable to deception is all observation; since we so often find two observers, in the presence of the same physical and palpable phenomenon, each describing it in his own fashion, and each giving a very different report respecting it."—*J. Luys.* According to Kant, the senses never deceive us, not because they always judge correctly, but because they never judge at all. The error lies in the inference which is drawn from the sensation.

What we have further to say on the subject of the senses will regard them principally as individuals, and be mainly directed to their training and cultivation, as this we regard as the great means of improving and strengthening the memory. In all training of the senses our endeavour must be to bring them to distinguish minute shades of difference.[1] The acuteness of any sense depends upon its power of discrimination. Not to be able to distinguish between one colour and another, or one sound, taste, or smell, and another, is to be so far defective in these senses; and, on the other hand, to be able to distinguish them in a high degree is to have these senses in a high state of perfection. We must, therefore, in the training of the senses, exercise them in distinguishing minute shades of difference in their objects.[2]

Wherever we can distinguish one object, or one part of an object, from another, we must believe that there is a like distinction in the physical conditions under

[1] "Every case in which an advancing intelligence distinguishes between objects or phenomena or laws that were previously confounded together as of like kind, implies a differentiation of states of consciousness." We see "in the series of phases through which each sense advances towards perfection" that "every higher phase shows itself as an ability to recognise smaller and smaller differences, either of kind or degree, in the attributes of surrounding bodies".—*H. Spencer.* "The more perceptive the senses are of difference, the larger is the field upon which our judgment and intelligence can act. Sensation mounts through a series of grades of 'just perceptible differences'."—*Francis Galton.* "The discriminative faculty of idiots is curiously low; they hardly distinguish between heat and cold, and their sense of pain is so obtuse that some of the more idiotic seem hardly to know what it is."—*Ditto.* Esquirol has connected the inaptitude of idiots and imbeciles, for education, with their dull sensibility. They see badly, hear badly, feel badly, and their sensorium is in consequence in a similar condition of sensitive poverty.

[2] "By merely practising the organs they become more discriminative, and differences are felt after a time that would originally have been unfelt."—*Prof. Bain.*

which we perceive them—that the course pursued by the one, or the parts affected by the one, differ in some measure from those affected by the other.[1] Where we cannot make such distinction, where the two seem so nearly identical that we cannot distinguish the one from the other, we may take it for granted that the same parts are concerned in both.[2] The aim of all training of the senses being to bring them to distinguish minute differences, the physical effect of this must be to introduce differences in the parts concerned, to restrict more and more each sensation to a distinct and more limited part of the organism. It is characteristic of all untrained activity that it is diffusive, while the effect of all training is to limit and confine mental power to special channels.[3] The more the mind is concentrated upon a particular object, or its activity confined to a particular part, the greater its power and force. The more we limit the parts concerned in any act of perception or other act, the more easily and efficiently is it performed, and the more readily is it fixed upon the memory. Hence in our remarks on the individual senses

[1] "There is a change made in the medullary substance proportional and correspondent to every change in the sensations."—*D. Hartley.* "Each distinct mode of consciousness, each distinct adhesive grouping, would appear to appropriate a distinct track of nervous communications involving a definite number of fibres and of cells or corpuscles."—*Prof. Bain.* "We have the strongest reasons for concluding that every feeling, every change in sensibility, has its correlative material process in the organism—is, in short, only the subjective aspect of the objective organic change."—*G. H. Lewes.*

[2] "Two objects completely similar, or which determine undistinguishable impressions upon us, are as if they were identical."—*Sir W. Hamilton.*

[3] "The boy when first learning to write is unable to prevent the simultaneous motions of tongue and legs, which are ludicrously irrelevant to the purpose of writing; but he learns to keep all his organs in subjection, and only the eyes and hands active. An analogous restriction takes place in thinking."—*G. H. Lewes.*

we shall treat them as much as possible analytically. (See Chapter VII., "Attention".)

The *muscular sense* is that by which we are made acquainted with the state and condition of the muscles, particularly when in action, and are thereby enabled to direct and control their movements.[1] It may be regarded as a sort of internal sense of touch, having its seat in the muscles, and revealing the state of their tension, in place of in the skin and acted upon by contact with foreign bodies.[2] These two senses have, indeed, much in common, and they generally go together, as in judging of weight, pressure, force, resistance, hardness, softness, &c. The sense of touch is more or less diffused over the body, while the muscular sense is confined to the muscles, especially such as are voluntary. The end plates in which the muscular nerves terminate, embracing as they do one-third or more of the circumference of their respective fibres, are particularly fitted for ascertaining the state of the muscles. It is by means of the muscular sense that we are made aware of the effort put forth in performing the different movements of the body, and are thus able to direct and control them.[3] Without it all voluntary movement—

[1] It is by means of the muscular sense "that we become conscious of the existing state of the muscles which are subject to the will, or rather to the position and direction of the limbs and other parts which are moved through means of the voluntary muscles, and we are thereby guided in directing our voluntary movements towards the end in view".—*Quain's Anatomy.*

[2] "The nerves of the muscles differ from those of the skin only . . . by terminating in the muscles and being excited by the stretching out or shortening of the muscles. But here there is no difference of action, the difference is in the excitant."—*H. Taine.* "In every different contraction of the muscles there is a difference of sensation." —*Jas. Mill.*

[3] "A harmonious combination of muscular actions must depend . . . on the capability of appreciating the condition of the muscles with regard to their tension, and to the force with which they are

movement directed by the will—would be impossible, except in so far as one of the other senses might be able to supply its place.[1]

The muscular sense is that which is first brought into action; for as motion precedes sensation, the fact of our having moved "must be made known to us by some feeling connected with the act itself. . . . We cannot as yet see that our limb moves; we must therefore in some manner feel that it does so; and this, in point of fact, is effected by means of the muscular sensations of the limb itself."—*Dean Mansel.*

By means of this sense we discriminate (1) between different degrees of exertion put forth, or called out; (2) the duration of different muscular sensations, giving an idea of time, as also of space in movement through space; and (3) between the speed or velocity of different movements. We thus by it determine the resistance of bodies, their force, weight, and other mechanical properties; measure distances and velocities; and ascertain the form, size, position, and so forth of external objects.

Our muscular movements greatly impress the memory, so that what we have done is usually easily remembered and recalled.[2] Through the retentive power inherent in

contracting."—*Dr. Kirkes.* "The skill which certain individuals acquire in the mechanical part of music, as well as the great dexterity of rope-dancers, tumblers, and jugglers, depend in a great measure upon their accurate perceptions of the contractions of the muscles."—*Dr. Bostock.*

[1] "No voluntary action can be performed without the assistance of a guiding sensation. . . . In the majority of cases the guiding or controlling sensation is derived from the muscles themselves"; but "if the muscular sense be deficient, one of the special senses may supply the requisite information".—*Dr. Carpenter.* "When the muscular sense is lost while the power of motion remains . . . the person cannot direct the movements of the afflicted limbs without the guidance of the eye."—*Quain's Anatomy.*

[2] "There is nothing so well remembered by us as the results of

muscle, by means of which what is once done comes by repetition to be more and more easily done, our present movements are moulded and guided by those that went before, and we come to be able by practice to regulate with great nicety the amount of energy requiring to be put forth in any particular case.[1] The importance of this will be seen if we happen to miscalculate, or are deceived as to the amount of effort necessary to be put forth in order to perform a particular movement, as in taking a false step, when not only is the movement ill-performed, but the system receives a shock not unlike that of electricity.

Our mental life is largely made up of experiences received through this sense. In ordinary cases we are unconscious of the effort put forth in the directing of our movements, but we are fully conscious of it at first in learning the movements, and also when called upon to exert it under unusual or trying circumstances, as when we attempt to stand or walk in a difficult or dangerous place.[2] The probability, therefore, is that these movements are always under the direction of the mind, though we may not be conscious of it. The effect of exercise on this sense is seen in the case of the blind, who by means of it are able to pursue a straight path, which is beyond the power of one who is only

our own actions," and "hence in studying natural processes we succeed best by making the observations and experiments for ourselves".—*Prof. Bain.*

[1] "When we are about to make a muscular effort, the amount of force which we put forth is governed by the mental conception of that which will be required as indicated by the experience of former sensations."—*Dr. Carpenter.*

[2] "A large amount of sensation is derived from the muscular sense, yet we are not aware of the nice adjustments of the muscles regulated by this sensibility when we sit or walk. No sooner are we placed in an exceptional position than we become distinctly aware of the effort."—*G. H. Lewes.*

blindfolded for the occasion.[1] In this, as in other cases where we usually rely upon sight, the inferior sense is deprived of its due amount of exercise.

By practice a very high degree of accuracy in the regulation of our movements is attained.[2] In drawing, painting, engraving, the power of directing the different movements and effecting the most delicate touches is very great. Persons dealing in articles sold by weight are able to form very precise estimates of the weight of such articles by balancing them in their hands.[3]

The pleasures derived from this sense are of a highly enjoyable kind. The feelings of freshness, vigour, activity, the consciousness of physical power, the sense of being able to encounter and overcome difficulties, all spring from this source. It is particularly in early life, when the limbs quiver with activity, and when it requires no inconsiderable effort to be still, that these feelings are most intense.

Touch.—The sense of touch is, physiologically considered, the simplest and least complex of the senses,

[1] "The blind man who has been accustomed to rely exclusively upon his muscular sense has no difficulty in keeping to a straight path, and moves onward with a confidence which is in remarkable contrast with the gait of a man who has been deprived of sight for the occasion only."—*Dr. Carpenter.*

[2] "By constant practice there is acquired from its exercise a peculiar skill and aptitude. It admits of infinite variety, as in active and passive motions, or in adaptation to various purposes with great nicety, as in estimating weight, balancing, throwing weapons, playing on various musical instruments, skilful workmanship, sense of resistance, &c., &c. Like the other senses, it adds largely to our feeling of pleasure and intellectual enjoyment."—*Dr. J. H. Bennett.*

[3] "According to the delicacy of the muscular tissue, we can by shorter or longer practice acquire distinct impressions from every standard of dimension, and can decide at once whether a given length is four inches or four and a half, nine or ten, twenty or twenty-one. . . . In drawing, painting, and engraving, and in the plastic arts, the engrained discrimination of the most delicate differences is an indispensable qualification."—*Prof. Bain.*

being, in fact, only an exalted form of common sensa- ion, while it is also the most generally diffused, existing n almost every part of the body.[1] Its seat is the skin, he entire surface of which is eminently sensitive, but t is especially on the palmar surface of the hands and ingers that it is most developed, and these are there- ore regarded as the principal organs of the sense.

The acuteness of this sense differs greatly in different arts of the body, depending, doubtless, mainly upon he number of terminal nerve filaments proceeding to he part, and their isolation from each other.[2] By neans of a pair of compasses it was ascertained that he two points could be perceived as distinct when line apart at the point of the tongue, 1 line on the almar surface of the third finger, and 2 lines on the ed surface of the lips and the palmar surface of the econd finger, up to 30 lines, or $2\frac{1}{2}$ inches, on the skin f the back over the spine, and on the middle of the rm and thigh. Considerable differences, however, are

[1] Touch "is the simplest and most rudimentary of all the special nses, and may be considered as an exalted form of common sensa- on, from which it rises by imperceptible gradations to its state of ighest development in some particular parts. It has its seat in the hole of the skin, and in certain mucous membranes, as that of the outh, and is therefore the sense most generally diffused over the dy."—*Todd and Bowman.* "We must consider the skin as a sen- ry organ which encloses our entire body, and is adapted to render ery part of the surface of our body sensible of external impressions, d, indeed, of impressions of manifold kinds, which arouse in us culiar sensations, and are inseparably connected with mental pro- sses."—*Prof. J Bernstein.*

[2] "The perfection of the sense of touch on different parts of the rface is proportioned to the power which such parts possess of dis- nguishing and isolating the sensations produced by two points aced close together This power depends, at least in part, on the mber of primitive nerve fibres distributed to the part."—*Dr. irkes.* "Whenever two points produce a double sensation, we may agine that one point lies on the area supplied by one distinct rve, while the other point lies on the area of a second nerve."— *of. Bain.*

found to exist among different individuals in this respect, some being able to distinguish the points at much less distances than others. If the points, in place of being stationary, are made to move over the surface, or, still better, if the surface is moved over them, the limit will be much diminished, probably to the extent of half or more. Hence the importance of having this sense most highly developed in those parts which are most capable of motion, namely, the hands.[1]

The objects of touch are principally solid substances, and their mode of action is by simple pressure, through which we estimate the hardness, softness, roughness, smoothness, &c., of substances with which we come in contact.[2] Prof. Weber found that the tips of the fingers could distinguish between the weights of 20 and 19·2 ounces. This is best done by placing the two successively upon the same part or finger, rather than the two together upon different parts or fingers. Much, too, depends upon the briefness of the interval between the two instances. "The difference between 14, or even 14·5, could be distinguished from 15 within 30 seconds; 4 and 5 could be distinguished within 90 seconds."—*Prof. Bain.* When the action of the muscles is introduced, by the hand being moved up and down, minuter differences will be distinguished. Weber

[1] The hand, "from its perfect adaptation to the uses to which it is devoted, its power, its delicacy, and the infinite movements which it can accomplish, is not surpassed as an example of the adaptation of means for the accomplishment of an end by any structure of the body".—*Dr. Dalton.*

[2] "Touch is that peculiar sensibility which gives the consciousness of the resistance of external matter, and makes us acquainted with the hardness, smoothness, roughness, size, and form of bodies. It enables us to distinguish what is external from what belongs to us, and while it informs us of the geometrical qualities of bodies, we must refer to this sense also our judgment of distance, of motion, of number, and of time."—*Sir C. Bell.*

infers that the measure of weight by mere touch is more than doubled by the play of the muscles. By touch and motion combined we receive notions of size, shape, direction, distance, and situation of bodies. Hence this sense and the muscular are valuable as auxiliaries to sight, at first instructing and informing it regarding these conditions of bodies, and afterwards serving to correct many indefinite or fallacious impressions that might be received from that sense alone. Owing, however, to our usually relying upon sight for information on these points, the muscular and tactile senses are not sufficiently exercised, and we do not have them in that efficiency that we should have.[1]

The sensations of heat and cold are so different from those of ordinary touch as to afford some ground for the opinion that they depend upon a different set of nerves.[2] There does not, however, seem to be sufficient evidence in support of this view, and there are several very strong objections that may be urged against it.[3]

[1] "Evidently at present as to the muscular and tactile sensations we have rough discrimination only; we can hardly distinguish their shades of difference for want of being compelled to do so. . . . With some blind persons the perfection of the sense of touch surpasses all imagination. . . . It is enough to see blind men read with their fingers books printed in relief almost as rapidly as we read books printed in black and white, to comprehend all the power of discrimination which our touch might have, but has not acquired."—*H. Taine.*

[2] Sir W. Hamilton thinks it probable that the sensation of heat depends on a peculiar set of fibres for two reasons: "1. Because certain sentient parts of the body are insensible to this feeling; and, 2. Because I have met with cases recorded in which, while sensibility in general was abolished, the sensibility to heat remained apparently undiminished".

[3] "There is no reason for supposing that any other nerves than those of touch are needed to arouse a sensation of warmth or of coldness."—*Prof. Bain.* "There is no adequate ground for the supposition that a set of nerve fibres is provided for their transmission distinct from those which minister to common sensation."—*Dr. Carpenter.*

We believe that most of the phenomena connected with this class of sensations may be explained by supposing that they are mainly owing to the action of the minute capillaries, which permeate all parts of the skin, upon the nerves. While touch may be said to result from direct pressure upon the nerves, heat or cold may act more directly upon the bloodvessels, causing them to expand or contract, and so affecting the nerves. Hence the sensation is more perceptible when a large surface is exposed to a change of temperature. A change which will be imperceptible to a single finger will readily be perceived if the whole hand be submitted to it.[1]

While regarded physiologically as the simplest of the senses, intellectually, touch is entitled to occupy a much higher place, whether we regard the number and variety of the ideas which it communicates to the mind, the pleasures or pains which may spring from it, or the important part which the mind plays in its operations.[2] In none of the other senses does man stand superior to all other animals, save touch, and Anaxagoras was wont to say that animals would have been men had they had hands.

[1] "If the forefinger of one hand be immersed in water at 104° and the whole of the other hand be plunged in water at 102°, the cooler water will be thought the warmer; whence the well-known fact that water in which a finger can be held will scald the whole hand."—*Dr. Carpenter.*

[2] "Why touch, the simplest and earliest sense, should in its higher forms be more than any other sense associated with the advance of intelligence," is explained by "the fact that tactual impressions are those into which all other impressions have to be translated before their meanings can be known". Hence "a highly elaborated tactual apparatus comes to be the uniform accompaniment of superior intelligence. . . . All handicrafts, and after them the higher processes of production, have grown out of that manual dexterity in which the elaboration of the motor faculty terminates. —*H. Spencer.*

The distinctness and intensity of a sensation of touch depends in great measure upon the degree of attention that is given to it. If the attention is strongly directed to any tactile sensation, the vividness of the impression is much increased; and by allowing the mind to constantly dwell on any form of physical suffering, however slight, it may be aggravated to almost any extent, and real diseases induced in parts through fancied ailments.[1] On the other hand, when the mind is thoroughly engrossed with any one object, it may become in a given measure insensible to all external impressions. Hence we find men possessed by one absorbing idea rising above all corporeal suffering, and enduring the most cruel tortures unflinchingly.[2] In no sense are subjective sensations more frequent than in that of touch—the mind having the power in a remarkable degree of exciting tactile sensations in parts, without any external cause, but simply by the power of imagination.[3]

[1] "The mind has a remarkable power of exciting sensations in the nerves of common sensibility. . . . The idea of pain gives rise to the actual sensation of pain in a part predisposed to it. A painful sensation becomes more intolerable the more the attention is directed to it."—*Dr. Kirkes.* "The constant direction of the attention to its supposed seat (*i.e.*, an imaginary disease) has a tendency to alter the organic action of the heart, and thus to induce real disease in the stead of that which was at first imaginary."—*Dr. Carpenter.*

[2] "The martyr borne above sensuous impressions is not only able to endure tortures when they come, but in great part to subdue and quench them. . . . The pinching and cutting of the flesh only add energy to the death song of the American Indian—even the slave under the lash is sustained by the indignant sense of his wrongs."—*. S. Wyld.*

[3] "It is remarkable that not merely are subjective sensations, like all others, rendered more intense by the direction of the attention to them, but they may be actually called into existence by the fixation of the attention on certain parts of the body. . . . If the attention be steadily directed to almost any part of the surface of the body, some feeling of itching, creeping, or tickling will soon be experienced."—*Dr. Carpenter.*

The mental ideas or impressions of this sense are very vivid and durable, and readily recalled, so that the different degrees of hardness, softness, weight, temperature, or other qualities of objects, can be determined by practice with a great measure of accuracy.[1]

That this sense is capable of being brought to a high degree of perfection is evident from the case of those who are under the necessity of using it frequently. People destitute of sight, for instance, and obliged to rely constantly upon this sense, come to acquire an acuteness and power of discrimination in it that seems almost incredible.[2] Cases are on record of such persons being able, by touch alone, to distinguish the colours of surfaces in other aspects alike, to distinguish between genuine medals and imitations, and to recognise individuals, after long periods of absence, by the mere contact of their hands.

Taste.—Of the remaining senses, taste is the one that is most nearly allied to that of touch. The tongue, which is the principal organ of taste, has also the sense

[1] "The after sensations left by impressions on nerves of common sensibility or touch are very vivid and durable. As long as the condition into which the stimulus has thrown the organ endures, the sensation also remains, though the exciting cause should have long ceased to act."—*Dr. Kirkes.* "Tactile sensations, whereby surfaces are discriminated, have a great degree of persistence in the recollection, something intermediate between tastes, and smells, and sights. . . . The cloth-dealer sees whether a given specimen corresponds with another piece that passed through his hands a week ago, or with a permanent standard impressed upon his finger sensibility."—*Prof. Bain.*

[2] "The improvement in the sense of touch in those persons whose dependence upon it is increased by the loss of other senses is well known."—*Dr. Carpenter.* "A familiar illustration occurs in the case of the blind, who, by constant practice, can acquire the power of reading raised letters, the forms of which are almost, if not quite, undistinguishable by the sense of touch to an ordinary person."—*Dr. Kirkes.*

of touch in the highest perfection.[1] In taste as in touch, the object requires to be brought into direct contact with the organ of sense before it can be perceived, which is not the case in smell, hearing, or sight. In addition to this, there is no special nerve of taste as there is of smell, hearing, and sight, for the nerves concerned in taste are also nerves of common sensibility. On the other hand, the sense of taste differs from that of touch in being confined to a particular part, and not generally diffused over the body, and in being acted upon chemically and not mechanically—the objects of taste requiring to be either liquid or soluble in the mouth in order to act upon the nerves.[2] If even the most sapid substance be applied to the tongue in a dry state, and the tongue itself be also dry, no taste will be felt. The effect is increased by moving the substance over the surface of the tongue—the sensation being more intense the larger the surface affected.[3] A short time must elapse after contact with the tongue before the taste of a sapid body is felt, and this varies according to the nature of the sub-

[1] "The experiments of Stich and Kllaatsch show that the sense of taste exists over the whole surface of the posterior third of the *dorsum* (or upper surface) of the tongue, on the under surface of the tip, and in a band or line about one quarter of an inch broad running along its edge. The sense is also well defined in the posterior parts of the hard palate, and in that portion of the soft palate which is near the bone. It is further present in the anterior pillars of the fauces. The middle and anterior part of the *dorsum*, the gums, posterior pillars of the fauces, and the inner surface of the lips, possess no sense of taste."—*Dr. J. H. Bennett.*

[2] "Every substance which possesses a distinct taste is more or less soluble in the fluids of the mouth, while substances which are perfectly insoluble do not make their presence known in any other way than through the sense of touch."—*Dr. Carpenter.*

[3] "Thus the wine-taster takes a small quantity of the liquor into his mouth, carries it rapidly over every part of its lining membrane, and then ejects it."—*Dr. Carpenter.*

stance.[1] After being exposed to two or three allied tastes alternately in succession, the sense becomes blunted, and loses its power of discriminating between them.

In general, the impressions of this sense have a longer persistence than those of smell, hearing, or sight, and everyone knows how long the taste of some powerful substance remains in the mouth, and obscures for a time that of all else.[2] As there is an open communication between the back part of the mouth and the nose, the sense of smell mingles largely with that of taste, as will readily be perceived by chewing some aromatic substance with the nostrils closed, when the taste will be very much diminished, if not actually lost.[3] The sense of touch, too, frequently mingles with taste; and many of the impressions which are commonly referred to taste are simply tactile, as for instance such as are derived from acrid, irritant, astringent substances.[4] Such is the power of this sense, that one part of sulphuric acid in 10,000 of water, one part of sulphate of quinine in 33,000 of water, and one part of strychnine in 1,000,000, can be detected when carefully compared with pure water.

Professor Bain makes a threefold division of the sensations of taste—namely (1) relishes and disgusts;

[1] "Saline solutions are most quickly perceived, sweet solutions less quickly, then acid, and lastly bitter substances.—*Dr. J. Marshall.*

[2] "Very distinct sensations of taste are frequently left after the substances which excited them have ceased to act on the nerve; and such sensations often endure for a long time, and modify the taste of other substances applied to the tongue afterwards."—*Dr. Kirkes.*

[3] "Some bodies, as cinnamon, have no taste, but only a flavour." —*Prof. Bain.*

[4] "The pungent sensations caused by mustard, pepper, &c., are owing to the excitation of touch, and should be separated from those of taste."—*Dr. J. H. Bennett.*

2) tastes proper; and (3) tastes involving also touch. Relishes are such as are in direct sympathy with the stomach, as the different kinds of food called savoury. The opposite of relishes is disgusts. Of tastes proper, the divisions are sweet, as sugar; and bitter, as quinine. The third class of tastes includes the saline, as salt; the alkaline, as soda; the acid or sour, as vinegar; the astringent, as alum; the fiery, as mustard; and the acrid, a combination of the fiery and bitter.

The organ of this sense, being situated at the entrance to the alimentary canal, is designed to guide us in the choice of our food, so that we may select what will be beneficial and avoid what may be hurtful.[1] There can be no doubt that if this sense were properly trained and directed, in place of being, as it generally is, led astray or perverted by excessive indulgence, it would be a much more reliable guide than it is at present.[2] "In the majority of instances of actual illness," says Sir H. Holland, "provided the real feelings of the patient can be safely ascertained, his desires as to food and drink may be safely complied with." [3] The enjoyment of life also depends largely upon the pleasures

[1] "There is an obvious continuity of structure in the tongue and alimentary canal, a common character of surface as regards mucous membrane, glands, and papillæ. . . . The tongue is in fact the stomach begun."—*Prof. Bain.* "The sense of taste assists us in the preference of food, and superadds the agreeable enjoyment of relish to the acts of eating and drinking."—*Dr. J. Marshall.*

[2] "We eat what we should not eat; drink what we should not drink; eat too much of what we may eat; and drink too much of what we may drink. And the result is that we ruin our health, enfeeble our bodies, dull our intellects, brutalise our feelings, and harden our hearts."—*Prof. G. Wilson.*

[3] "In the case of invalids, the suggestions of the sick man's palate are often safer than the dicta of the medical adviser."—*Dr. J. Marshall*

derived through this sense.[1] A patient who was suffering under its deprivation said: "Everything I eat seems to me to be earth".

Like the other senses, that of taste is capable of being greatly improved by cultivation. The wine-taster, tea-taster, cook, or chemist acquires an acuteness of taste that is quite beyond the power of ordinary individuals.[2]

There appear to exist certain relations among tastes such as we find among colours and sounds, some modifying, intensifying, or harmonising those with which they are associated. Thus the taste of cheese improves the flavour of wine, while that of sweet substances destroys it. By the addition of sweet substances, sour or bitter tastes may be made pleasant, but no such change can thereby be effected on saline tastes. The whole art of cooking depends on the proper combining and harmonising of tastes.[3]

Smell.—Closely allied to the sense of taste is that of smell. They are both situated at the entrance to the

[1] "As it is the sense having the custodiership of the animal wants, so in the exercise of this charge there is no sense more largely contributory to our every-day enjoyments, animal spirits, health, and comfort."—*R. S. Wyld.*

[2] "The experienced wine-taster can distinguish differences of age, purity, place of growth, &c., between liquors that to ordinary judgments are alike; and the epicure can give an exact determination of the spices that are combined in a particular sauce, or the manner in which the animal on whose flesh he is feeding was killed."—*Dr. Carpenter.*

[3] "There appears to exist the same relation between tastes as between colours, of which those that are opposed or complementary render each other more vivid, though no general principles governing this relation have been discovered in the case of tastes. In the art of cooking, however, attention has at all times been paid to the consonance or harmony of flavours in their combination or order of succession; just as in painting and music the fundamental principles of harmony have been employed empirically, while the theoretical laws were unknown."—*Dr. Müller.*

alimentary canal, and are primarily designed to inform us of the nature and qualities of our food.[1] Smell being possessed of a keener and more subtle perception than taste, and dealing with qualities of a different kind, enables us to distinguish substances that to taste alone appear identical.[2] Further, as we have said, much of the discriminative power that is commonly ascribed to taste depends in reality upon smell. Being seated at the principal entrance to the lungs, it likewise serves to test the purity of the air we breathe. It also affords a refined, delicate, and not over obtrusive pleasure, and gives an additional beauty and charm to many objects of nature.

The objects of smell require to be in an aeriform or gaseous state, as those of taste require to be in a state of solution. They are conveyed into the interior of the nose in the ordinary act of breathing, and the mucous membrane being in a moist state lays hold of and acts upon them. The action of this sense, like that of taste, is generally believed to be a chemical

[1] "The great practical object of the sense of smell is doubtless in man, as in other animals, to assist in the choice of food."—*R. S. Wyld.* "It is a law in reference to ourselves—to which, so far as I know, there is no exception—that there is not any substance having a powerful smell of which it is safe to take much internally."—*Prof. G. Wilson.* "Nearly all substances with a bad smell have an injurious effect upon the body."—*Prof. Bernstein.*

[2] "How 'passing wonderful' are the various scents . . . that fill the air, yet when they fall upon the fine membrane of the nose . . they are inhaled, distinguished, and called by name! They sail in numerous squadrons, close to our eyes, and close by our ears, yet are so amazingly attenuated that they elude the search of both! Nevertheless, so judiciously are the olfactory nets laid, and so artfully their meshes sized, that they catch these vanishing fugitives. They catch the roaming perfumes which fly off from the opening honeysuckle, and take in the stationed sweets which hover round the expanded rose. They imbibe all the balmy fragrance of spring, all the aromatic exhalations of autumn, and enable us to banquet even on the invisible dainties of nature."—*J. Hervey.*

one. Most bodies throw off from their substance minute particles of matter, or it may be that the air acting upon the exposed surfaces of bodies dissolves minute portions of their substance, and these, held in suspension in the atmosphere, constitute their smell. The extreme minuteness of these particles is evident from the fact that a grain of musk will impregnate a large quantity of air for years without any sensible diminution of its weight.[1]

In order to smell it is necessary that the odorous particles enter the nostrils in a current of air, for one may be in a room impregnated with odour, and be insensible to its presence, if he do not breathe it through the nostrils—breathing only through the mouth.[2] On the other hand, in order to perceive a smell most distinctly or powerfully, recourse is had to sniffing, by which the air containing the odorous particles is drawn up forcibly against the upper part of the mucous membrane lining the nose, where the sense of smell is most acute. In order to smell the mucous membrane requires to be in a moist state. When this is dry the sense is impaired or lost. In like manner, odours are not nearly so readily perceived in a dry as in a moist atmosphere. On the other hand, an excessively moist state of the mucous membrane, as when suffering from a cold, impairs or destroys smell. Some time elapses

[1] "The minuteness of the particles of bodies acting on the sense of smell has often been dwelt upon as a striking example of the divisibility of matter. Sulphuretted hydrogen in the atmosphere in the proportion of one to a million is distinctly perceptible. Ammonia is perceptible in the proportion of 1 to 33,000."—*Prof. Bain.*

[2] "Odorous substances in general are such as can be readily acted on by oxygen;" and "unless a stream of air containing oxygen pass into the cavities of the nostrils along with the odoriferous effluvia no smell is produced".—*Prof. Bain.* "By breathing through the mouth we may avoid being affected by odours even of the strongest and most disagreeable kind."—*Dr. Carpenter.*

ıfter the particles reach the mucous membrane before hey are perceived, as in taste, and the effect often persists for a long time after the cause has been removed. Jnder the continued action of the same stimulus the ensation rapidly diminishes in intensity, and may soon ease to be perceived. Man is inferior to many animals n the acuteness of this sense for particular odours, but ıe excels them all in the variety of objects to which it xtends.

Though our nomenclature of odours is exceedingly estricted, "there are," says Prof. Wilson, "probably s many odours as there are colours or sounds".[1] 'arious classifications of odours have been attempted. innæus divides them into seven different classes: (1) romatic, as the carnation; (2) fragrant, as the lily; (3) mbrosiac, as musk; (4) alliaceous, as garlic; (5) fœtid, as ıgwort; (6) virulent, as the Indian pink; and (7) nauseous, as the gourd. Professor Bain has three principal lasses: (1) odours in sympathy with the lungs, (2) ıose of smell proper, and (3) those involving excitaon of the nerves of touch. In the first class he has esh odours, or such as accelerate the action of the ıngs, as eau-de-cologne, and close or suffocating odours, hich depress the action of the lungs. He has also ere nauseous or disgusting odours, which manifest a ympathy with the stomach. In the second class are weet or fragrant odours, as of the rose; and their pposites or malodours, as of assafœtida. In the third ass are pungent odours; as of mustard; ethereal odours,

[1] ". . . Let those who doubt this visit a scientific chemist's labotory and examine his specimens one by one, and they will easily tisfy themselves that a fac-simile of the largest church organ might adily be constructed in which each organ pipe sounding a different te should be represented by a phial exhaling when opened a differnt odour."—*Prof. G. Wilson.*

as of alcohol; appetising odours and flavours, as of cinnamon.

The sense of smell, like the other senses, may be brought to a very high degree of perfection by cultivation.[1] In blind persons this sense is sometimes so acute that they are able to distinguish individuals by it. In the well-known case of James Mitchell, who was blind, deaf, and dumb from his birth, it was his principal means of distinguishing persons, and enabled him at once to perceive the entrance of a stranger. Among savage tribes, too, who depend much on this sense, it is very acute.

Besides its importance as an instrument in the discrimination of bodies, and in extending our knowledge of the world around us, as a valuable source of pleasure and of mental enjoyment, it demands much more care and attention than it commonly receives. Mental associations frequently cluster round sensations of smell more strongly than round any other sensations we receive from without.[2] The suggestive power of odours is to many persons greatly superior even to that of sight. Among the civilised nations of antiquity, as among the Oriental and Southern peoples of the present

[1] "The wine-merchant, the distiller of perfumes, the manufacturer of drugs, the grower of scented plants, the tobacco-dealer, and many others, have, by long training, educated themselves to distinguish differences of odour which escape an uneducated and unpractised nostril, however acute by natural endowment."—*Prof. G. Wilson.*

[2] "Why should, at times, a passing scent,
Just sniffed a moment on the breeze,
Its sensuous power so swiftly spent,
Come laden with more memories
Than the low hum of honey bees,
Or sound of old familiar strains,
Or rustling of the autumn grains,
Or voices from the whispering trees,
Or the running brooks or the pattering rains?"
—*Olrig Grange.*

lay, the pleasures of this sense were much more cultivated, and the use of perfumes much more common, than with us; while among the ancient Hebrews the use of incense entered largely into the worship of God.[1]

Hearing.—In hearing and in sight we have to deal with higher classes of sensations, and more complex organs, than those already mentioned. In touch, taste, and smell, the objects or their particles require to be brought into direct contact with the terminal nerve apparatus in order to be perceived, whereas in hearing and in sight the peripheral end filaments of the nerves terminate in enclosed sacs, containing a fluid substance by which they are protected and kept in a constantly moist state, and through which they are acted upon. This contrivance is doubtless rendered necessary by the delicate and susceptible nature of their structures, for were they subjected to the drying and other influences of the atmosphere, or kept in a moist state only by such means as those adopted for taste or smell, they could not retain their delicacy. If by any accident this fluid escapes from the ear, entire and incurable deafness is the result, in like manner as blindness results from loss of the humours of the eye. Sonorous waves give rise to no sound when directly acting upon the end filaments of the auditory nerve.[2]

[1] "To an ancient Hebrew, in the days when symbols spoke to men's imaginations as they do not now to ours, it seemed most natural to regard incense as prayer, and to feel, when the perfumed smoke was ascending from the altar, as if it were the voice of the High Priest, in silent eloquence, making a new confession of the sins of the people, beseeching forgiveness for them, and offering their thanksgivings to God."—*Prof. G. Wilson.*

[2] "Waves of sound falling on the auditory nerve itself produce no effect whatever; it is only when, by the medium of the endolymph, they are brought to bear on the delicate and peculiar epithelium cells which constitute the peripheral terminations of the nerve, that sensations of sound arise."—*Dr. M. Foster.*

Sound, the object of hearing, is a special sensation produced by the vibrations of some sonorous body—solid, liquid, or gaseous—conveyed to the ear, and affecting the auditory nerve.[1] All sonorous bodies are bodies in a state of vibration; and when such vibrations are communicated to the ear with sufficient rapidity and force, a sensation of sound is the result. The sonorous body, which vibrates in air, throws the air which surrounds it into similar vibrations; and these, extending in waves, enter the ear, and acting upon its delicate apparatus, impress the end-filaments of the auditory nerve.[2]

The ear is specially constructed for receiving impressions from the surrounding air, and unless conveyed by the air or some other medium, no sound can reach the ear.[3] A bell rung in an exhausted receiver gives forth no sound. In hearing, then, we do not take cognisance of the sonorous body directly, but only of the effect produced by it upon an intervening medium—the air—which acts upon the organ of hearing.

The atmosphere whose vibrations impart sound to the ear is regarded as composed of an infinite number of atoms, acted upon and governed by two nicely-balanced forces—mutual repulsion and attraction—so

[1] "The sensation of sound is excited by the concussion of the acoustic nerve, occasioned in most cases by the vibration of the external air."—*H. Taine.*

[2] "Every body which vibrates in the air throws the air which surrounds it into similar vibrations. . . . The vibrations consist of condensations and expansions of the air, which follow one another like circles of waves upon the surface of water."—*Prof. Bernstein.*

[3] "Sound can pass through solid bodies also without the intervention of air, and reach the labyrinth in this manner."—*Prof. Bernstein.* "There are instances, for example, of persons who are totally deaf to sounds produced by excitements of the air, but who can hear the sound of a watch or a bell when held by the teeth, the sound being then conveyed by the bony and other portions of the head to the auditory nerves."—*Prof. Airy.*

as to admit of the greatest freedom of motion among each other. In vibrations of the atmosphere, then, we have a state of alternate condensation and rarefaction, and sound is produced when these succeed each other with a certain rapidity and intensity.[1] The lowest and highest number of vibrations in a given time that are audible to the human ear are variously given by different authorities; and in this respect great differences exist among individuals—some perceiving sounds so deep as to be inaudible to other ears; others, sounds of so high a pitch as to be generally unheard. According to Helmholtz and others, vibrations under 16 or over 38,000 in a second are quite inaudible, though for most persons the range is much less, not exceeding 16,000.[2] All sound, whatever its pitch or intensity, travels at the same rate, being in dry air at 32° Fahr. 1090 feet per second, but it varies with the elasticity and density of the air.[3]

Professor Bain distinguishes sounds considered as sensations into three classes: "The first comprises the

[1] "The atmosphere may be described as consisting of an infinity of atoms capable of moving freely amongst each other, and which are held separate by virtue of a law of mutual repulsion, each atom repelling its neighbours, and tending to fly farther asunder. . . . Sound is produced by a succession of quick, minute condensations and rarefactions in the air, and these must follow each other with a certain velocity in order to excite that sensation."—*R. S. Wyld.*

[2] "The gravest sound audible to the human ear is (according to Helmholtz) 16 vibrations a second; the highest audible sound, 38,000 vibrations a second, being a compass of 11 octaves."—*Prof. Bain.*

[3] "The velocity of sound in air depends on the elasticity of the air in relation to its density. The greater the elasticity, the swifter the propagation; the greater the density, the slower is the propagation. . . . The velocity of sound in water is more than four times its velocity in air. The velocity of sound in iron is seventeen times its velocity in air. The velocity of sound along the fibre of pinewood is ten times its velocity in air."—*Prof. Tyndall.*

general effects of sound as determined by quality, intensity, and volume or quantity, to which all ears are sensitive. The second class includes musical sounds, for which a susceptibility to pitch is requisite. Lastly, there is the sensibility to the articulateness, distance, and direction of sounds, which are the more intellectual properties."

The first and principal difference between sounds experienced by the ear is that between noises and musical tones, every variety of which depends on the rapidity, form, size, and order of succession of the vibrations. In musical tones, the vibrations are periodic, or succeed each other at regular intervals; in noises, they follow each other irregularly.[1] Musical tones begin to be perceived at about 30 vibrations in a second, but a determinate musical pitch is not perceptible till about 40 vibrations are reached.[2]

Musical tones are distinguishable from each other (1) by their intensity, force, or loudness; (2) by their pitch or relative height; and (3) by their quality or *timbre*. The intensity, force, or loudness of a tone depends upon the extent or amplitude of the vibrations,—the greater the extent of the vibrations the louder the sound. Pitch depends on the number of the vibrations that strike the ear in a given time,—the greater the number of vibrations the higher the pitch. As the number of vibrations increase, the time occupied by each diminishes, and the length of the wave is shortened. Hence, the shorter the vibrations or waves

[1] "The sensation of a musical tone is due to a rapid periodic motion of the sonorous body; the sensation of a noise, to non-periodic motions."—*H. Helmholtz.*

[2] "The musical tones which can be used with advantage, and have clearly distinguishable pitch, have between 40 and 4000 vibrations in a second, extendng o ver seven octaves."—*H. Helmholtz.*

f sound the higher the tone, and the longer the waves ie deeper the tone. The quality, colour, or *timbre* of tone is that peculiarity attaching to each, which enders it easy to distinguish notes of the same in- ensity and pitch proceeding from different instruments. 'hus we can readily distinguish the same note as oming from a piano, a violin, a flute, &c. This has een proved by Helmholtz to arise from the presence f a certain number of overtones, which are produced ith every tone which is sounded.[1] These overtones re usually called the *harmonics* of the given funda- ental tone. They are present to a greater or less tent in the sounds of all instruments used in music, id it is their presence and strength that give to each nd of instrument its peculiar tone. Thus each usical tone is a compound made up of a series of fferent tones—the first being the fundamental, or ime partial tone of the compound, and the rest its rmonic upper partial tones.

Great differences exist among individuals with regard the acuteness of this sense, and some possess it in eater perfection in certain directions than in others. ne whose hearing is good for sound in general may t have but little ear for musical tones; and, on the her hand, one with a good ear for music may yet be ficient as regards hearing in general.[2] Some ears,

[1] "The difference between sounds, otherwise the same, proceeding m different materials, instruments, or voices . . . are now ex- ined by the presence of auxiliary upper tones in all instruments, ich tones vary with the material and the instrument."—*Prof. in.*

[2] "In different individuals the sense of hearing is more perfect sounds of different pitch;" and "one whose hearing is good as far regards the sensibility to feeble sounds, is sometimes deficient in power of recognising the musical relation of sounds, and in the se of harmony and discord; while another individual, whose

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again, are more acute for articulate sounds, or sounds of a particular kind, than others. There also appear to be considerable differences among individuals as to the time it takes for an impression to reach consciousness or to be apprehended by the intelligence. There are persons who have no difficulty in hearing sounds, but yet fail in readily interpreting or understanding them. This is frequently the case with persons in old age, or suffering from mental debility, and is to be attributed to a condition of mind rather than to any defect in the organ of hearing.[1] What is commonly termed deafness is not unfrequently to be attributed to this cause—the sounds being heard, but not being interpreted or recognised through mental defect or failure of memory. The power of attention is strongly marked in regard to this sense, and sounds may be distinctly heard when the attention is directed towards them that in ordinary circumstances would be imperceptible; and people often fail to hear what is said to them because they are not paying attention.[2]

The power of perceiving the direction of sounds is not a faculty of the sense of hearing, but is an act of the mind judging from experiences previously acquired.[3]

hearing is in other respects imperfect, has these endowments".—*Dr. Kirkes.* "It is even possible for a person whose hearing is very defective from disease to have a better ear for musical sounds than has another person who is not at all deaf."—*W. Harvey.*

[1] "Persons on whom old age or debility brings deafness frequently describe themselves as having no difficulty in hearing sounds, but as being unable to disentangle and identify words when they are indistinctly and rapidly uttered." This defect "is most marked early in the day, and is diminished by whatever invigorates the circulation". —*H. Spencer.*

[2] "That one-half of the deafness that exists is the result of inattention cannot be doubted."—*W. Harvey.*

[3] In hearing "we must distinguish two different points—the audible sensation as it is developed without any intellectual inter-

rom the modifications which the sensation of sound ndergoes according to the direction from which it aches us, the mind infers the position of the sounding ody. In forming this judgment we are doubtless eatly aided by the possession of two ears. In like anner the distance of the source of a sound is not cognised by the sense itself, but is inferred from its tensity.

The ear ranks as the most intellectual of our senses ter the eye, while as a power of moving our emotional ture, and calling forth our activities, it is superior en to that.[1] To the majority of mankind music is a eater source of enjoyment than a scene or a picture.[2] ne ear is the organ by which man listens to the voice his fellow-man, and the wail of anguish, the cry of y, the word of exhortation, find an entrance here to inmost soul, moving him, it may be, to deeds of the eatest self-denial or of the utmost heroism.[3]

ence, and the conception which we form in consequence of that sation".—*Dr. Kirkes.*

"All the delights of music, all the charms of society, all the ver of language, all the expressions of love, pity, anger, remorse, , and fear, which we encounter in our way through life—all are the developments of the one elementary perception of sound as veyed to us through waves of the atmosphere in combination h the susceptibility of the appropriate organ."—*J. D. Morell.* at is received by the ear makes a deeper impression on the d than anything received through the organs of sight. It is a wn thing that nothing so much awakens the Switzer's longing home as the peculiar series of modulations, without any words, ch compose the so-called *Ranz des vaches*, which is only to be rd in that country, but which has neither music nor melody in —*W. von Humboldt.*

" A love of music is much more frequent than a love of painting culpture ; and you will reach the hearts and touch the feelings he majority of mankind more quickly by singing them a song 1 by showing them a picture."—*Prof. G. Wilson.*

In the hands of genius the sense of hearing " is made to move ently with the pastoral ditty ; to excite our pity or desire ; to stir

Almost everything in nature may be said to have its voice by which it speaks to man, who is thus, as it were, brought into fellowship and sympathy with it.[1] Without the hearing ear all nature is silent, and stripped in a great measure of its charms.[2] To be without this sense, to be shut out from listening to the voices of our fellow-men, to be cut off from all the sounds of nature, is a heavier privation than even the loss of sight.[3]

The ear is the sense that is most closely associated with the voice and speech.[4] It guides and directs the action of the vocal organs, in much the same way that the action of the muscles is guided by the muscular sense.[5] Language is also primarily and most directly

up a national, patriotic, or martial spirit; to celebrate a victory; to subdue us with devotional melodies; or to overwhelm us with those marvellous creations of the human soul and mind, the grand and majestic combinations of the oratorio".—*Dr. J. Marshall.* "The firmness of a word and a gesture has often staid a flying army, and the fate of nations has turned upon the tones of determination sounded by a single patriot."—*R. S. Wyld.*

[1] "It is the sense through which all nature speaks to us in her manifold voices, excites within us the higher emotions, and feeds the sense of harmony, which is a mental quality."—*Dr. J. Marshall.*

[2] "Apart from sound, the outward world has a dreamlike and unreal look—we only half believe in it, we miss at each moment what it contains."—*H. R. Haweis.*

[3] "It is a sorer affliction to be cut off from listening to the tongues of our fellow-men, than it is to be blinded to the sights on which they gaze."—*Prof. G. Wilson.* "Deafness tries the temper more, isolates more, unfits for social converse, cuts off from the world of breathing emotional activity tenfold more than blindness."—*H. R. Haweis.*

[4] "Sound is the leading element in language, both spoken and written. We hear the words even when we see them, but we do not see them when we hear them."—*G. H. Lewes.*

[5] "It appears that the vocal organs are usually guided in their action by the sensations received through the ears, in the same manner as other muscles are guided by the sensations received through themselves." In vocalisation "the delicate gradations in

ıddressed to the ear, and it is by the ear that it is most eadily learnt.[1] In learning a language, nothing is of nore importance than an ear well trained to nicely liscriminate and treasure up different kinds of articulate ounds. The ear is the natural companion of the ongue, not the eye, and a language learned by the ear omes more readily and naturally to be spoken than vhen learned by the eye. It is by the ideas of the ounds as heard, rather than of the words as seen, that language is learnt. Further, the mind is more impressed by hearing than by seeing, and the language hich is taken in by the ear is more readily and deeply nplanted in the memory than that which is acquired ırough the eye; in like manner as what is said to us sually impresses us more deeply than what we merely ead.[2] Hence we hold that in teaching the ear should e much more frequently called into exercise than it is

e action of each individual muscle, and the harmonious combinaon of the whole, are effected under the guidance of the ear without ave in exceptional cases) the smallest knowledge on our own rts of the nature of the mechanism we are putting in action".—*Dr. rpenter.*

[1] "In the first phases of the development of the young child, it is leed acoustic impressions that first awaken his mind and lead him reproduce the sounds that strike his ears. . . . It is by means of s series of acts that human speech, the natural daughter of auditory citations, becomes developed in us, expresses itself outwardly, and nifests through precise and appropriate sounds the emotions of e sentient personality which is in action."—*J. Luys.* "Language ongs, in the first instance, to the ear, and is afterwards by a nsfer of associations conveyed to the eye. . . . When language is ntally employed as a vehicle or medium of cogitation . . . it is the nd rather than the written sign that is thought of."—*Isaac ylor.* "It would seem pretty obvious that, so far as the infant nks by means of language, it does so by means of the remembered nds, these are its linguistic symbols of thought."—*Dr. Bastian.*

[2] "The mind is more concentrated in hearing than in seeing, and ear is less apt to be distracted than the eye by the obtrusion of rounding objects."—*Dr. B. Rush.*

at present, and that pupils should not only learn their lessons by reading them, but also from hearing them read, and from instruction received *viva voce.*[1]

It is of the utmost importance that this sense be fully educated and trained in order that we may receive all the advantages from it that it is capable of affording, as well as all the pleasure and enjoyment that it can so richly bestow.[2] The ear is more susceptible of education, and may be more readily trained than perhaps any of the other senses.[3] Of the degree of perfection to which it may be brought by education, we have evidence in the case of those persons who have to exercise it frequently, or who are greatly dependent upon it, as the blind. An orchestral conductor can detect the slightest departure from time or tune in

[1] "Instruction by the living voice has this advantage over books, that as more natural it is more impressive. Hearing rouses the attention and keeps it alive far more effectually than reading."—*Sir W. Hamilton.* "The truth of these remarks is confirmed by the fact of few of the sayings or songs learned by the ear only and in the nursery being ever forgotten."—*Dr. B. Rush.*

[2] "Is it not a thing to be deeply lamented that the sensitive ears with which almost everyone of us has been gifted by God are so little educated? . . . As for training them to that exquisite sense of melody or harmony of which they are susceptible, how few do it! . . . Let everyone so train and educate and fully develop the faculty of hearing that is in those ears of his, that he may listen with full delight and appreciation to the song of birds and the roar of the sea, the wailing of the winds and the roll of the thunder; and may be able to cheer his soul and calm his heart by hearkening to the music of his fellow-men, and in turn rejoice their hearts by making music for them."—*Prof. G. Wilson.*

[3] The ear "is still more susceptible of education than the eye, and can be educated more quickly".—*Prof. G. Wilson.* "The quickness of perception with regard to all sounds, those especially which are faint or distant, is much improved by exercise and culture, and on the other hand deteriorated by inattention and neglect."—*W. Harvey.* "By cultivation hearing becomes, like all the senses, very acute—as in the Indian, who listens on the ground for the distant footfall of his enemy or his prey."—*Dr. J. Marshall.*

the sound of one out of a number of instruments, and indicate without hesitation the faulty performer; and a blind man is able to thread his way safely through a crowded thoroughfare by the acuteness of his ear alone.[1]

Sight.—The sense of sight is the highest and most important of all our senses.[2] It deals with the greatest number of objects, gives us the most varied information respecting them, and thus furnishes the mind with the greatest number of its ideas concerning the material universe. While most of the other senses reveal only one quality or property of an object, as its taste, smell, or sound, sight makes known various properties, as colour, form, size, roughness, smoothness, and the like, as well as place, distance, direction, &c. Touch is the only one of the senses that, in this respect, bears some resemblance to sight, and hence sight is sometimes viewed as extended or distant touch.[3] Touch, however, requires to be brought into direct contact with its objects before it can feel them, while sight can take cognizance of objects a great distance

[1] "The extraordinary perfection and acuteness of hearing often attained by the blind prove that the faculty of hearing, like all the other physical powers of the human frame, is capable of high development . . . under diligent cultivation."—*W. Harvey.* "They can even tell when they are passing a stationary object (such as a lamp-post), provided it be as high as the ear, or nearly so, by the reverberation of the sound of their own footsteps, and can discriminate between a lamp-post and a man standing still in the position of one by the same means."—*Dr. W. B. Carpenter.*

[2] "Of all our members, the eye has always been held the choicest gift of nature—the most marvellous product of her plastic force."—*Prof. Helmholtz.* "Our sense of sight is the most perfect and delightful of all our senses."—*Prof. G. Wilson.*

[3] "Our sight may be considered as a more delicate and diffusive kind of touch that spreads itself over an infinite multitude of bodies, comprehends the largest figures, and brings into our reach some of the most remote parts of the universe."—*Prof. G. Wilson.*

off. In this respect, too, sight is superior to any of the other senses, which require to be either in immediate contact with, or within a limited distance of, their objects, in order to perceive them.

Sight is, at first, largely dependent upon the other senses for its information. It is by means of touch that it acquires its first notions of the form, size, distance, direction, &c., of bodies, but after a time it comes to furnish us with this information without reference to touch. Thus children manifest a great desire to handle and carry to the mouth whatever they see. In like manner, the senses of hearing, taste, and smell first inform the eye regarding such of the properties of objects as they take cognizance of, and then the eye comes to associate these properties with the sight of the object without their aid. We acquire our first knowledge of language by the ear, but after we have learnt to read we come to associate the meanings of the different words with their visible forms, and not with their sounds. Hence, when from the sight of an object we gather all the information we require respecting it, we do not think of calling in the aid of the other senses, so that they do not usually receive that amount of exercise and training that should fall to them. It is only in those cases where sight is wanting that we find the other senses in that state of efficiency in which they should be.

This sense is specially fitted to guide and direct our physical activities. By means of it we are able with accuracy to determine the position, distance, size, form, and other properties of the objects around us, so that we can readily and without difficulty move among them, act upon them, touch and handle them. Thus we can at once lay our hand upon any object within

each, make our way in safety amid obstacles that impede our progress, strike a ball, thread a needle, drive a nail, and perform a multitude of other operations, every one of which depends upon the information afforded us by the eyes.[1] Besides this, it reveals to us the manifold beauties of nature, with all their wealth of form and colour, of sunshine and shade, of action and repose, and, stretching far into space, takes account of those distant worlds that sparkle in the heavens.[2] Without this sense our knowledge of the external world would be meagre and imperfect, and our enjoyment of nature very much diminished. It continues longer in action, and suffers less from fatigue than any of the other senses, and its pleasures have usually a higher degree of persistence, and are more easily recoverable than those of any other sense.[3]

The sole object of sight is light, with its various modifications of shade and colour. Light was formerly

[1] We owe to the eye "the security and exactness with which we can judge by sight of the position, distance, and size of the objects which surround us. . . . Whenever we stretch forth the hand to lay hold of something, or advance the foot to step upon some object, we must first form an accurate optical image of the position of the object to be touched, its form, distance, &c., or we shall fail."—*H. Helmholtz.*

[2] "It is by the eye alone that we know the countless shining worlds that fill immeasurable space; the distant landscapes of our own earth, with all the varieties of sunlight that reveal them; the wealth of form and colour among flowers; the strong and happy life that moves in animals."—*H. Helmholtz.* "Were all the interesting diversities of colour and form to disappear, how unsightly, dull, and wearisome would be the aspect of the world! . . . The ever-varying brilliancy and grandeur of the landscape, and the magnificence of the sky, sun, moon, and stars, enter more extensively into the enjoyment of mankind than we perhaps ever think or can possibly apprehend without frequent and extensive investigation."—*Dr. Dwight.*

[3] Sight "fills the mind with the largest variety of ideas, converses with its objects at the greatest distance, and continues the longest in action without being tired or satiated with its proper enjoyments".—*Prof. G. Wilson.*

supposed to consist of minute particles of matter given off in all directions from luminous bodies, and travelling with immense rapidity;[1] but the generally received opinion now is that it is occasioned by the undulations of an extremely attenuated and subtle fluid or ether, which pervades all space and penetrates all substances, occupying the interstices between their atoms, and vibrating freely, particularly in such substances as are transparent. While at rest it is inappreciable by our senses, but when acted upon by luminous bodies it is thrown into a succession of waves which, entering the eye, produce our sensations of light and colour.[2] Thus light resembles sound in the mode of its action, but while the latter travels at the rate of only about 1090 feet in a second, the former speeds at the amazing rapidity of about 186,000 miles in the same space of time.[3]

[1] Newton "adopted a corpuscular theory: he imagined light to consist of excessively minute particles of matter projected from luminous bodies, with the immense velocity of nearly 200,000 miles in a second".—*R. S. Wyld.*

[2] "Of late certain difficulties in the explanation of the recently discovered properties of light, especially its polarisation, have tended to revive the doctrine maintained by Descartes, Huygens, and Euler, viz., that all the phenomena of light depend on the undulations of a highly attenuated fluid or ether universally diffused throughout space, which, while at rest, is inappreciable by our senses, but when acted on by luminous bodies is thrown into a succession of waves. Luminous bodies are thus supposed to act on the universally diffused fluid somewhat in the same manner that sonorous bodies do on air in the production of sound."—*Encyclopædia Britannica, Art.* "*Light*". "Physics teach us that light is transmitted by the ether, a substance of extraordinary tenuity, which extends throughout the universe, penetrates all substances, exists also in empty space, and that it is produced by vibrations of the ether of extraordinary rapidity."—*Prof. Bernstein.*

[3] "Light is without doubt the most wonderful natural agent we are acquainted with; pervading, as it appears to do, infinite space; streaming from age to age from the remotest orbs the telescope can

Just as in sound, differences of pitch in musical tones are due to the rate of the undulations of air, so differences in colour are owing to the rate of the undulations of the ether. It has been ascertained that the number of undulations necessary to produce the sensation of red is no less than 482 billions in a second, while the number of those necessary to produce the sensation of violet, at the other end of the spectrum, amounts to 707 billions a second, the other prismatic hues having each its appropriate number between these two.[1] Since the different kinds of light travel with equal velocity, it follows that the length of each wave is conversely proportionate to its duration. Thus the wave length of the extreme red ray is 0·0,000,266 of an inch, and that of the extreme violet only 0·0,000,167. The number of undulations in an inch is, for the ex-

reach, and with a velocity which baffles our comprehension."—*R. S. Wyld.*

[1] "Modern optical discoveries teach us that every point of a medium through which a ray of light passes is affected with a succession of periodical movements recurring regularly at intervals not less than four hundred millions of millions of times in a second; that it is by such movements communicated to the nerves of our eyes that we see; nay, more, that it is the *difference* in the frequency of their recurrence which affects us with the sense of the diversity of colour; that, for instance, in acquiring the sensation of redness our eyes are affected four hundred and eighty-two millions of millions of times; of yellowness, five hundred and forty-two millions of millions of times; and of violet, seven hundred and seven millions of millions of times per second."—*Sir John Herschel.* "A man counting as hard as he can repeat numbers one after another, and never counting more than a hundred, so that he shall have no long words to repeat, may perhaps count ten thousand, or a hundred a hundred times over, in an hour. At this rate, counting night and day, and allowing no time for rest or refreshment, he would count one million in four days and four hours, or say four days only. To count a million a million times over he would require four million days, or, roughly, ten thousand years; and for five hundred millions of millions he must have the utterly unrealisable period of five million years."—*S. Butler.*

treme red, 37,640, and the extreme violet, 59,750, the others being intermediate.[1]

Besides the undulations that produce light or colour, there are others which, from being either too slow or too rapid, do not give rise to luminous sensations. Below the red the undulations do not produce light but heat, and above the violet they have only a chemical action. The former are therefore known as the dark heat rays, the latter as the dark chemical rays, of the spectrum. The illuminating or light-giving power is greatest in the yellow portion of the spectrum, and diminishes rapidly towards the red on the one side, and the violet on the other.

The colour of an object is caused by the rejection or reflection of certain of the coloured rays, the others being absorbed. Thus an object appears red when all the coloured rays are absorbed with the exception of the red, which are reflected. Where all the rays are absorbed the object appears black, where all are reflected white. Thus the colour of bodies depends on the rays they reject or radiate, not on those they absorb.

Those colours which, when combined, constitute white are always harmonious when associated together. Thus blue, yellow, and red; orange, green, and violet; red and green; yellow and violet; blue and orange, are harmonious. The unharmonious colours, on the other hand, are such as contain only a part of the constituents of white, as red and yellow, red and blue, yellow

[1] "An increase of speed and diminution of length in the waves are sufficient to determine the variations which our sensation of colour undergoes in passing from red to violet. . . . Helmholtz distinguishes the following successive colours—red, orange, golden yellow, pure yellow, greenish yellow, pure green, bluish green, blue of water, cyanic blue, indigo, violet, and ultra-violet."—*H. Taine.*

and blue. The agreeableness of the sensations produced by harmonious colours is doubtless owing to the wave action of their rays being in accordance with the natural action of the nerve force, and tending to restore the disturbed equilibrium of the retina and optic nerve.

Colour, therefore, does not exist as such in the object itself, which simply reflects or transmits a certain number of billions of undulations a second, and these are perceived as colour only when they fall upon the retina of a sentient being. Light and colour have no existence apart from the seeing eye, except as mechanical impulses or undulations.[1] The sensation of light may be produced by any irritation of the optic nerve, as by a blow or pressure upon the eyeball, a shock of electricity, &c.

The sensations of sight are excited by the action of light upon the retina of the eye, where the ultimate fibres of the optic nerve terminate. This action consists in forming upon the retina an image or representation of what is before it, and this is effected by means of the rays of light which all objects, being either luminous in themselves or reflecting the light transmitted to them from other bodies, send forth. In the eye we have an optical instrument of great fineness and delicacy, composed of various parts, beautifully adjusted for receiving impressions of external objects, and imprinting them on the retina,

[1] Light "is the product of undulations of the ether and of retinal sensibility. Both factors are indispensable to the product; but either may potentially exist independently of the other."—*R. S. Wyld.* "Colour does not exist as such in the object itself, which has merely the power of reflecting or transmitting a certain number of millions of undulations in a second; and these only produce that affection of our consciousness which we call colour, when they fall upon the retina of the living percipient."—*Dr. Carpenter.*

whence they are transmitted by means of the optic nerve to the brain.[1]

The great acuteness of this sense is owing to the vast number of extremely minute nerve fibres spread out on the retina.[2] An object of only $\frac{1}{500}$ of an inch in diameter is usually visible to the naked eye; and if it powerfully reflect the light, it will be visible though much smaller.[3] A line is much more readily seen than a point, and objects which cannot be discerned when single become visible if placed in a row. We are able to see two points as distinct when they subtend an angle of about 40 seconds.

[1] "The essential constituents of the optical apparatus of the eye may be thus enumerated: a nervous structure to receive and transmit to the brain the impressions of light; certain refracting media for the purpose of so disposing of the rays of light traversing them as to throw a correct image of an external body on the retina; a contractile diaphragm with a central aperture for regulating the quantity of light admitted into the eye; and a contractile structure by which the chief refracting medium shall be so controlled as to enable objects to be seen at various distances."—*Dr. Kirkes.*

[2] "The great superiority of the eye as a medium for perceiving the outer world lies in the power of independent sensibility to minute points" arising from "the minute size of the subdivisions of the retina capable of independent sensation. . . . The nerve of vision must needs consist of a number of independent fibres, maintaining their distinctness all the way to the brain, and capable of causing distinct waves of diffusion throughout the entire cerebral mass. . . . In the act of perceiving the objects about us, this distinctness enables us to hold in our minds all the parts of a complicated scene, each in the proper place, without mingling or confusion. . . . In the nerve of sight there cannot probably be less than one hundred thousand fibres, and there may be many more."—*Prof. Bain.*

[3] "It is possible to see a brilliant point in an angle even so small as $\frac{1}{4}$ of a second, and a sharp eye can see a body the $\frac{1}{50}$ of a line in diameter, that is, about the $\frac{1}{600}$ part of an inch."—*Prof. M'Kendrick.* "Dr. Alfred Mayer estimated and demonstrated by actual experiment that the smallest black spot on a white ground visible to the naked eye is about $\frac{1}{300}$ of an inch at the distance of normal vision—namely, 10 inches; and that a line, which of course has the element of extension, $\frac{1}{5000}$ of an inch in thickness, could be seen."—*Anon.*

The duration of a stimulus, in order to call forth a visual sensation, may be exceedingly short; and the impression made upon the retina has a certain persistence after the removal of the cause, varying with the brightness of the original light, and the existing condition of the eye, from $\frac{1}{50}$ to $\frac{1}{30}$ of a second.[1] Two or more sensations will appear as one if the interval between them be less than from $\frac{1}{30}$ to $\frac{1}{50}$ of a second, and here we have an explanation of a number of curious visual phenomena. It is well known that if an ignited point be moved rapidly round in a circle, it ceases to be seen as a single point, and presents the appearance of an unbroken circle. It is in consequence of this persistence of an image on the retina that the winking of the eyelids forms no impediment to continued vision. Light must be of a certain intensity to produce a luminous impression, and after the retina has been for some time in the dark its excitability is increased.

The various movements of the eye are effected by six nicely adjusted muscles, of which four are straight (*recti*) and two oblique. By means of these acting singly or in combination, the various nice and intricate movements of the eye are performed. They are largely concerned in almost every act of sight, and serve to bring the different parts of an object successively into the axis of vision where the sense of sight is most acute. They also enable us to follow objects in motion,

[1] "Impressions made upon the retina do not disappear instantly, but gradually fade away, and in so doing occupy a certain period of time, which varies with the brightness of the original light, the existing condition of the eye, and the illumination to which it is exposed. . . . It is a phenomenon analogous to that of the continuance of sound in the ear, and subserves an important purpose of keeping vision continuous and distinct during the winking of the eyelids."—*Dr. Draper.*

and to determine their direction, velocity, &c.; and by means of them we judge of the form, size, and other qualities of objects, distance, direction, and the like.[1]

Sight is undoubtedly the most intellectual of our senses, whether we regard the number and variety of the ideas which it presents to the mind, the highly refined nature of its enjoyments, or its constant and unwearied activity.[2] In none of the other senses does the mind itself come so largely and so manifestly into play. What is seen by the bodily eye is only a small part of what is conveyed to the mind through this sense. In the former we have only the outline or form and colour of certain objects imprinted upon the flat surface of the retina; and out of these, with their extreme delicacy and minute variations, the mind forms that endless variety of ideas that go to make up our visible world. The retinal field of vision is very limited, but the field of vision as presented to the mind is of no determinate limit. All the objects depicted upon the retina are represented on a plane surface, whereas to the mind they appear as standing at various distances. It is only through the experience gained by practice that we are able to distinguish the different distances of objects. Indeed, visual images are little more than signs, which

[1] "Many of the aspects of the external world impress themselves upon the moving apparatus of the eye. The surface of the sea, the drifting of clouds, the fall of rain, the waving of trees in the wind, the rushing of water, the darting of meteors, the rising and setting of the sun, and all mixed impressions of spectacle and movement."—*Prof. Bain.*

[2] "As regards intellect, the sensations of vision have a marked superiority among the senses. They admit of being identified and discriminated to an extraordinary extent . . . and they have a corresponding superiority as respects their being retained and remembered. . . . Neither tastes nor smells, nor touches nor sounds, can compare with sights in the property of mental persistence and revivability."—*Prof. Bain.*

the mind learns by degrees to understand and interpret; and the images and their interpretation come to be so closely interwoven in the mind, that it is difficult or impossible in all cases to say what belongs to the one and what to the other, and yet it is of consequence to keep the distinction clearly in view.[1] From the large part that the mind plays in our visual sensations, we are liable to be deceived in regard to what we actually see, particularly when under strong mental excitement.[2]

Indeed, careful training is necessary in order to be able to see clearly and accurately what is before us—to see all the parts of a complex whole in their due proportion and in their proper relation to each other. Simple as it may seem, it is very difficult for the untrained eye to observe accurately what is before it.[3]

[1] "The mind is constantly co-operating in the acts of vision, so that at last it becomes difficult to say what belongs to mere sensation and what to the influence of the mind."—*Dr. Kirkes.* "The figure of a cube or sphere, distance, and magnitude are not acquired by vision alone. Persons who have been suddenly cured of blindness have no conception of the distance or magnitude of objects."—*Dr. Abercrombie.* "Regarding the perception of solidity . . . Mr. Wheatstone now inclines to the view that there is a mental effect produced over and above the optical effect, which mental suggestion overrides the optical impression, and gives a perception really different from the literal sensation."—*Prof. Bain.*

[2] "The eye looks, but it is the mind that sees; and when the mind contemplates phenomena under a preoccupation of thought, it interprets them in the light of its own idea; so that unless that general idea be a right one, its views of every phenomenon are in some measure perverted."—*Edward White.* "The mind may be readily deceived even in spite of itself, as the phenomena of the stereoscope prove; and spectres having their origin in natural or diseased conditions of the brain may accurately replace images that have been painted in the eye."—*Dr. Draper.*

[3] "To the natural philosopher, the descriptive poet, the painter, and the sculptor, as well as to the common observer, the power most important to cultivate, and at the same time hardest to acquire, is that of seeing what is before him."—*G. P. Marsh.*

It must be taught to observe, to compare, to analyse to look at things on all sides, in order to see correctly As the sense of touch is largely employed in the firs instruction of this sense, it should be frequently had recourse to in its after-training. In no other sense i the constant verification of what is perceived, or imagined to be perceived, more necessary than in this.[1]

There exists in many respects a close analogy betweer the senses of sight and hearing. If we strike a bar o iron it emits a sound; if we strike it frequently and rapidly it becomes red-hot, and gives forth light. Both light and sound travel from their source, and become feebler the farther they are removed from it. Both are capable of reflection, and in both the angle of reflection is the same as the angle of incidence. In form and colour we have beauty and harmony and their opposites, as we have sweetness and harmony and their contraries in sound. While the ear notes its objects with regard to time, the eye contemplates its objects with regard to space. The ear and eye furnish the mind with the greatest number of its ideas, the impressions conveyed by them are most vivid and lasting and they are also those that most powerfully affect our emotional nature and stimulate our mental and physical activities.

Sight possesses a wonderful power over our muscular movements in exciting, as well as in directing and controlling them. The sight of a particular movement

[1] "In most objects of sight there are numerous parts. . . . Of these, the parts that are more seen by one man are less seen by another; whence it is probable that from an object of any complexity no two men ever receive precisely the same sensations."—*James Mill.* "The harmonious results of the perceptions of feeling and of sight depend even in the adult upon a constant comparison of the two."—*H. Helmholtz.*

immediately calls out the desire to imitate it; and this feeling is particularly strong in the young, and constitutes an important auxiliary in their education. In like manner, when the eye is steadily fixed upon any of our movements, particularly if they be of an unusual or difficult nature, it is in general more accurately performed than when this is not the case. The child, in learning to walk or dance, fixes his eyes upon his feet, as he fixes them upon his fingers in learning to play the piano.[1] Indeed, skill in handicrafts and in the use of weapons depends more upon the training and acuteness of the eye than is commonly supposed.[2] The marksman, the bowler, the billiard-player, must each fix his eye intently upon the object at which he aims.[3] In certain kinds of paralysis the patient has the command of his limbs as long as his eyes are fixed

[1] "In learning to dance, the scholar desires to look at his feet and legs, in order to judge by seeing when they are in a proper position. By degrees he learns to judge of this by feeling; but the visible idea left partly by the view of his master's motions, partly by that of his own, seems to be the chief associated circumstance that introduces the proper motions."—*D. Hartley.* "Where the movements which it is desired to execute are complex and difficult, and we have to learn them by imitation of the movements of other persons, the sense of sight is then doubly brought into play. It is necessary at the commencement and during the continuance of our efforts to copy such movements to look alternately at our model and at our own moving members."—*Dr. Bastian.* "The difficulty of imitation is greatest of all in those parts not within the sweep of the eye, as the head and features."—*Prof. Bain.*

[2] "In mere mechanical copying, as in handicraft operations, military drill, dancing, posture, and the like, . . . granting a sufficient flexibility and variety of the spontaneous movements—that is to say, facility, the observant and imbibing eye is the next grand requisite."—*Prof. Bain.*

[3] "Skill in marksmanship, whether with firearms or other projectile weapons, depends more upon the training of the eye than is generally supposed, and I have often found particularly good shots to possess an almost telescopic vision."—*G. P. Marsh.*

upon them, but loses it the moment they are with drawn.[1]

As a rule, we remember best what we have seen and in cases of loss of memory we often find that th sensations of sight are retained, while those of th other senses are lost. Thus a sentence when writte has been found to be readily understood, though whe spoken it was unintelligible; and on the other hand persons have been found able to write what, from mer obliviousness of the sounds, they were unable to utter Some persons, too, may have observed that when i doubt as to the spelling of a word, they have been pu right by recalling the appearance of it or by writing i down. All artificial modes of improving the memor are based upon associating what we wish to remembe with visible objects.[2]

To see clearly is a valuable aid even to thinkin clearly. In all our mental operations we owe muc to sight. To recollect, to think, to imagine, is to se internally,—to call up more or less distinct visua images of things before the mind.[3] In order to under

[1] "The patient who cannot feel either the contact of his foot wit the ground or the muscular effort he is making, can manage to stan and walk by looking at his limbs; and the woman who cannot fee the pressure of her child upon her arms, can yet sustain it so long a she keeps her eyes fixed upon it, but no longer."—*Dr. Carpenter.*

[2] "We must connect the things we wish to remember with th immediate objects of our senses that offer themselves daily to ou attention, but particularly with the objects of our sight, the mos vigorous and lively of all our senses, and of which the objects ar perhaps more numerous than those of all our other senses pr together."—*Prof. Barron.* "When a variety of ideas are associate together, the visible idea, being more glaring and distinct than th rest, performs the office of a symbol to all the rest, suggests them and connects them together."—*D. Hartley.*

[3] "To recollect, to imagine, to think, is to see internally, and t call up the more or less enfeebled and transformed visual image o things."—*H. Taine.* "Cohering trains and aggregates of the sensa

stand a thing it is generally necessary to see it, and what a man has not seen he cannot properly realise or image distinctly to his mind.[1] Hence the importance in education, of teaching as much as possible by the eye,—showing the objects we wish to be known, and going through the operations we wish to be understood and followed.[2] The sight of an object will usually give a more clear and lasting impression of it than any amount of verbal description. The fixing of the eye intently upon an object seems to have the power of holding the thoughts, and preventing them from wandering, even though the object may have no real connection with the subject of our thoughts. The restless, unsettled eye of the insane, unable or unwilling to fix itself upon any object, has probably much to do with the wild thoughts that are coursing through

ions of sight make more than any other thing, perhaps more than all other things put together, the material of thought, memory, and imagination."—*Prof. Bain.*

[1] "The child, and perhaps the man as well, only knows well what is shown him, and the image of things is the true medium between their abstract idea and his personal experience."—*A. Vinet.*

[2] "I am of opinion that it is more than ever needful we should teach as much as possible by the eye,—that in teaching any branch of natural science the *demonstration* should be combined with *oral* description. The student should see what is described; and where it is not possible for the teacher to exhibit illustrative specimens, good models, drawings, and explanatory diagrams should be supplied."—*Dr. L. S. Beale: The Microscope.* The distinguished surgeon, Professor Syme, in speaking of the system he introduced of bringing the patients before his pupils, says: "The great advantage of this system is that it makes an impression at the same time on the eye and ear, which is known by experience to be more indelible than any other, and thus conveys instruction of the most lasting character. . . . It is only when an impression is made upon the eye that oral instruction in regard to such matters produces a lasting impression; and unless the student can be shown either the things spoken of, or some evidence of their operation, little will be retained of what is told him, however important may be its bearing upon his professional life."

his brain. Absorbed on what is going on within, h cannot, or will not, give attention to anything els which might tend to dispel the fascination.[1] Hence, i all probability, the change of scene that is commonl recommended in such cases acts in the way of servin to recall his thoughts to what is going on around him There seems even reason to believe that if the eye wer well trained and duly exercised it would tend, in man cases, to prevent insanity.

The eye has a wonderful power in lighting up an animating the countenance, and reflects in a larg degree what is passing in the mind. Every passion o the mind has its appropriate expression in the eye which sometimes speaks with a power and an eloquenc that cannot be equalled even by the lips.[2]

The sense of sight is capable of extraordinary im provement by education, and that in the way either o increased quickness or readiness in the perception o objects generally, or in the power of discerning bodie of extreme minuteness, and in discriminating th slightest shades of difference in form, size, colour, &c.[3]

[1] "In a general way in persons with hallucinations . . . th phenomena of the external world no longer produce in the sensoriun anything more than an abortive impression. . . . The patient, thu shut up from external sounds, a stranger to everything that passe around him, lends but an inattentive ear to the things of the externa world. He lives, as people say, in himself, upon remembrances o the past, and upon his habitual delirious conceptions."—*J. Luys.*

[2] "It is chiefly the eye which betrays in our face the state of ou mind and thoughts; and this is done for the most part by the move ment and position of the eyeball, associated with which are, o course, the action of the facial muscles, of the eyelids, as well a the power possessed by the eye of accommodating itself to a chang of circumstance. A troubled look lowers the eyes, an animated on raises them; and thus the mind, while it derives mental nourish ment from without through the eye, reveals its inner actions throug the same organ."—*Prof. Bernstein.*

[3] "The sense of vision may vary in its degree of perfection, as re

Γhe exercise of the sight in one direction, or on one class ɔf objects, does not of necessity improve or strengthen t in other directions, or for other classes of objects. In each case there is developed a certain readiness or ıptitude for noting appearances, or minute shades of lifference, of particular kinds, which pass unnoticed by hose who have not been accustomed to observe the ame kind of phenomena.[1] It is by the habitual irection of our attention to the effects produced upon ur consciousness by the impressions made upon the ye and transmitted to the sensorium that our sight, ke our other senses, is trained. (See "Attention".)

ırds either the faculty of adjustments to different distances, the ɔwer of distinguishing accurately the particles of the retina affected, nsibility to light and darkness, or the perception of the different ıades of colour."—*Dr. Kirkes.*

[1] "The microscopist, who is constantly on the outlook for the ırious forms of organic structure with which his mind is familiar, scerns these without difficulty or hesitation where an ordinary ɔserver sees nothing but a confused jumble of tissue."—*Dr. ırpenter.*

CHAPTER V.

MENTAL IMAGES.

"After an object is removed or the eye shut, we still retain an image of th thing seen, though more obscure than when we saw it; and this it is the Latin call imagination, and apply the same . . to all the other senses. But the Greek call it fancy (*Phantasia*), which signifies appearance."—*Malebranche.*

Aristotle maintains "that of every object of thought there must be in th mind some form, phantasm, or species; that things sensible are perceived an remembered by means of sensible phantasms, and things intelligible by intelligib phantasms; and that these phantasms have the form of the object without th matter, as the impression of a seal upon wax has the form of a seal without i matter".—*Lord Kames.*

"The word image is borrowed from the history of vision; strictly, it onl denotes the cerebral revival of the optical sensation; it is by extension that we hav applied the same name to the cerebral revival of muscular and tactile sensation, sensations of sound, taste, and smell."—*H. Taine.*

"The word image must be understood as designating any recalled feeling whatever kind which wants something of the signature and energy of the feeling after-feeling it recalls. It may be a sight, a sound, a taste, a touch, a pain, a effort, a terror, a word."—*G. H. Lewes.*

We may define an image, then, as "a repetition or revival of the sensation while at the same time we distinguish it from the sensation," among other thing "by its origin, since it has the sensation as its antecedent, while the sensation i preceded by an excitation of the nerve".—*H. Taine.*

"Sensation and after-sensation have their origin in an objective stimulus, th image has its stimulation from within."—*G. H. Lewes.*

"That which constitutes recollection or an act of memory is the present imag which a past sensation has left in us, an image which . . . seems to us the sensatio itself."—*H. Taine.*

THE physical motion or change which occasions a sensation must be apprehended by the mind befor it can be perceived or become an object of conscious ness. Impressions are, doubtless, being constantl made upon the senses, and their influence conveyed t the brain, that never come within the range of con sciousness, because the mind fails to apprehend them

In order that a sensation may be taken up and perceived by the mind, it is necessary that an image of it be formed. The mind can take no account of the physical movements or changes that may be taking place in the body, except in so far as they give rise to mental images.[1] It can perceive nothing, understand nothing, remember nothing but images.[2]

We use the term "mental image" in preference to the corresponding word "idea," employed by Locke and others, in consequence of the frequent vagueness and indefiniteness of the latter.[3] A mental image may be said to be the mental side of a physical change or

[1] "It is the mental not the bodily impression that constitutes the actual perception."—*Dr. Carpenter.*

[2] Is not thought "principally a calling up and arranging before us of the images of physical things which have been given us through sense? . . . Even in thinking of moral and abstract subjects, we shall find that they present themselves to us embodied in somewhat of a sensuous or physical garb, and at least always with distinct time and space properties, for these are essential elements of human thought."—*R. S. Wyld.* "To recollect, to imagine, to think, is . . . to call up the more or less enfeebled and transformed visual images of things. . . In all the higher operations we affect by means of abstract names—judgment, reasoning, abstraction, generalisation, combination of ideas—there are images more or less effaced or more or less distinct."—*H. Taine.* "Locke holds that we cannot perceive, remember, nor imagine anything but by having an idea or image of it in the mind."—*Lord Kames.* "Nothing is remembered but through its idea."—*Jas. Mill.*

[3] "The word 'idea' . . being that term which I think serves best to stand for whatsoever is the object of the understanding when a man thinks, I have used it to express whatever is meant by phantasm, notion, species, or whatever it is which the mind can be employed about in thinking."—*John Locke.* "The word 'idea,' as one prostituted to all meanings, it were perhaps better altogether to discard. As for the representations of the imagination, or phantasy, I would employ the terms image or phantasm, it being distinctly understood that these terms are applied to denote the representations, not of our visible perceptions merely as the terms taken literally would indicate, but of our sensible perceptions in general."—*Sir W. Hamilton.*

condition of body—a mental representation, or a representation to the mind of a physical fact. In sensation, as we have seen, all that passes from the organ of sense to the brain is a form of motion. The sense-organ is acted upon by an external object, and a form of motion is set up which is conveyed to the brain, and from the different kinds of motion so conveyed the mind constructs images to itself of all the vast variety of qualities or properties that we commonly attribute to external objects.[1]

These images grow and acquire strength and clearness by slow degrees. To the opening mind of the child the beautiful landscape or the lovely flower presents only vague patches of colour. But by degrees, as the same sensations are repeated, the mind comes to distinguish the different parts, and the images formed of them in the mind become more distinct and clear.[2]

[1] "The impression on the nerve can have no resemblance to the ideas suggested in the mind. All that we can say is that the agitations of the nerves of the outward senses are the signals which the Author of Nature has made the means of correspondence with the realities. There is no more resemblance between the impressions on the senses, and the ideas excited by them, than there is between the sound and the conception raised in the mind of that man who, looking out on a dark and stormy sea, hears the report of a cannon, which conveys to him the idea of despair and shipwreck."—*Sir C. Bell.*

[2] "The eye learns to discriminate colours and shades of colour where at first there was only a vague blur of feeling. The flower we see is not seen by the infant; what the infant sees is what he has learned to see; slowly the blur of feeling differentiates, and the stem, leaves, petals, &c., once observed, are ever after observable; they then exist for the observer. Did they not exist before? Certainly they did, but only for some observant mind, not for the infant. . . . To the mind of a philosopher, every fact of colour is a complex of visible and invisible facts, which differs from what it is in the mind of a child or a peasant as the idea of a lily in the mind of a botanist differs from that in the mind of a savage."—*G. H. Lewes.*

The infant mind is at first only conscious of sensations: it simply receives the impressions that are made upon it by external objects. It knows nothing of what they are or whence they come—has, in fact, no perception of them. By degrees, however, as the same sensations recur, it comes to act upon them: it compares the present impression with the images of past impressions of the same kind; marks in what they resemble and in what they differ from each other; distinguishes them as different from the *Ego*, or I, and as belonging to the *Non-Ego;* localises them; and, in a word, perceives them.[1] Perception is that act of the mind by which we refer sensations to particular parts of the body or to external objects. In every act of perception what is perceived is not so much what is actually present to the sense at the time, as the result of a number of past sensations of a similar kind which come into the mind at the same time, and serve to explain or make clearer and more manifest this one.[2] Hence, the more frequently we have a particular sensation in the mind, the more do the images of past sensations come into the formation of the present image, which thus becomes more general and less particular.[3]

[1] "There can be no perception of an object—nothing but vague feeling—unless with present sensations there are linked other sensations in ideal reproduction."—*G. H. Lewes.*

[2] "The mind, according to Cudworth, perceives, by occasion of outward objects, as much more than is represented to it by sense as a learned man does in the best-written book, than an illiterate person or brute."—*Dugald Stewart.*

[3] "Artists are as a class possessed of the visualising power (that is, of seeing well-defined images in the mind's eye) in a high degree, and they are at the same time pre-eminently distinguished by their gifts of generalisation. They are of all men the most capable of producing forms that are not copies of any individual, but represent the characteristic features of classes."—*F. Galton.*

In order to consciousness a change from one state or condition of mind to another is necessary. We are only conscious of a new sensation or thought as we feel it to be a change from a past sensation or a previous thought. While the new sensation is present the past sensation exists in the mind as an after-sensation or image. Did the past sensation disappear entirely from the mind the moment it was past there would be no consciousness of change, and consequently no sensation. Hence, philosophers tell us that if we were constantly subject to one impression it would be as if we had no impression at all, for the mind would have no consciousness of it.

Further, in order to recognise a present impression as the same as or similar to a past, we must have an image of the past impression in the mind. A man might look on the face of his most intimate friend and fail to recognise him if he had not an image of that friend in his mind. He might perceive him as a person, but if his mind were absorbed in something else, or if he were what is termed "absent-minded," there might no image present itself to his mind by which he could recognise him. When one is engaged in seeking for a thing, if he keep the image of it clearly before the mind, he will be very likely to find it, and that too, probably, where it would otherwise have escaped his notice.[1] So, when one is engaged in thinking on a subject, thoughts of things resembling it, or bearing upon it, and tending to illustrate it, come up on every side. Truly, we may well say of the mind, as has been said of the eye, that

[1] "No one ever found the walking fern who did not have the walking fern in his mind. A person whose eye is full of Indian relics picks them up in every field he walks through." They are "quickly recognised because the eye has been commissioned to find them".—*J. Burroughs.*

"it perceives only what it brings with it the power of perceiving".[1]

A mental image is no mere mental abstraction, but, like all the properties of mind, it has a material basis, and possesses many of the characteristics of matter. It is an image of something that we have seen, or felt, or thought, or done; and as these have all a material basis, so in our view have the images that belong to them. In recalling the image of a past sensation—in other words, in recollecting it, or representing it to the mind—not the brain alone, but also the special organ of sense is called into exercise. That the body is largely concerned in the formation of these images is evident from the fact that a large measure of nervous waste takes place during the operation. It is probably in this process that the greatest amount of nervous waste takes place, and it is this that first feels fatigue. In reading a book, in listening to a discourse, in studying a subject, it is not the eye that tires with seeing or the ear with hearing, but it is the image-forming power of the mind which becomes fatigued, in which state we may read page after page of a book, or hear sentence after sentence of a speech, and have little or no notion of the meaning intended to be conveyed. When the subject is familiar or interesting, this process of image-formation is less arduous, and may be carried on for a considerable time without fatigue; but when, on the other hand, the subject is unfamiliar or distaste-

[1] Where two pictures are put before the two eyes, "it is not enough to form the conscious intention of seeing first with one eye and then with the other; we must form as clear a notion as possible of what we expect to see. Then it will actually appear. If, on the other hand, we leave the mind at liberty, without a fixed intention to observe a definite object, that alternation between the two pictures ensues which is called retinal rivalry."—*H. Helmholtz.*

ful, the labour of forming the images is much greater, and the mind soon becomes fatigued.

This subject of mental images is one that has hitherto received but little attention, and yet it is one of the deepest interest, and calculated to throw light upon many obscure mental phenomena. Whenever a sensation or an idea is presented to the mind, a mental image or conception of it must be formed in order to its being perceived or understood. In proportion to the clearness and distinctness of the image will be the understanding of it by the mind and the hold taken of it by the memory.

As there are different kinds of sensations and different classes of ideas, there exists a like variety among mental images, and some minds excel in some, others in other.[1] Thus some may excel in the formation of visual images, others of auditory ones. The former will remember best those things that are presented to the eye, and of which they can form visual images; the latter, such as are addressed to the ear, and form auditory ones. The former will take in and remember most readily what they read, the latter what they hear; the one will learn a language most easily by the eye, from books; the other by the ear, from conversation.

[1] "In the normal state, we think by words mentally heard, read, or pronounced, and what passes through our minds are images of certain sounds, certain letters, or certain muscular and tactile sensations of the throat, the tongue, and the lips."—*H. Taine.* "Our intellectual operations are indeed mostly confined to the auditory feelings (as integrated into words) and the visual feelings (as integrated into impressions and ideas of objects, their relations and their motions)."—*H. Spencer.* When "by aid of mental words I follow out a long train of reasoning," I have "in my mind . . . the image of the sounds and vocal movements which my arguments would require if uttered aloud, the image of the gestures, emotions, and events which my conduct would excite in myself and others".—*H. Taine.*

Some, in whom the visualising faculty is very strong, may, in listening to a discourse, image every word they hear as it appears to the eye; while others, with the auditory faculty largely developed, will image what they read as if it were addressed to the ear.[1] Others, again, in reading or in listening to a discourse, will attend only to the sense or meaning, and form sense-images. These can give the substance of what they have read or heard with great accuracy, though they may not perhaps be able to recall any of the words. In each case it is of importance to ascertain in what direction the image-forming power of the mind chiefly lies.[2]

Further, not only are there images of the eye and ear, and of the other senses, but there are also images of muscular movements as of the tongue and hand.[3] Some

[1] "Every word heard may excite a visible idea, and every word seen an audible one."—*D. Hartley.* "If a man with an acute faculty of hearing, but a preference for thinking by the agency of mental sight, listens to a lecture, he sits with his eyes closed, and, unconsciously perhaps, pictures the words he hears as if writing them. . . . Another person will convert the impressions he receives by sight into sounds. . . . A man who uses mental sight in this way will gaze intently when he forgets anything, or perhaps closes his eyes to avoid distraction; while a person who employs mental sound is more likely to put his finger to his lips as though to enforce silence, and perhaps incline his head as though listening."—*Dr. M. Granville.* "The memory is aided in hearing, and after reading, by shutting the eyes."—*Dr. B. Rush.*

[2] "The man who remembers by sound will find it easier and better to recall a fact, event, or circumstance, by some formula which connects it by sound, than by trying to picture the subject; while the reverse will be the case with the man who remembers by sight. The latter must fancy he sees the object, or recall to mind some written or printed description of it, before he can remember the details."—*Dr. M. Granville.*

[3] "We remember our verbal utterances partly as connected threads of vocal exertion. . . . A well-known aid to verbal memory is to write with one's own hand what has to be remembered."—*Prof. Bain.*

may not remember much of what they see or hear, but remember readily what they say or do. Hence some children learn best by repeating aloud, others by writing down what they wish to remember. Most persons have probably observed, in writing a word in regard to the spelling of which they are sometimes in doubt, that if they write it at once without thinking about it, they usually spell it correctly, but if they doubt and hesitate and think, they become uncertain, and most probably spell it wrong.[1] The reason is that the mental image which directs the hand is, in this instance, a surer guide than that furnished by the intellect. In such cases, the more the mind is engaged in thought the less able is it to listen to those inner promptings of our nature—the muschlar images of past movements, on which so much that is finest and most delicate in our actions depends.[2]

[1] "We frequently experience when we are in doubt about the spelling of a word that the greater voluntary exertion we use, that is, the more intently we think about it, the farther are we from regaining the lost association between the letters of it, but which readily recurs when we become careless about it."—*Dr. E. Darwin.* "As everyone knows, a writer is less likely to make egregious errors in spelling . . . if he be so absorbed in the matter of what he is writing as to give no conscious attention to forms of words or construction of sentences."—*A. S. Hill.*

[2] "If a performer has forgotten some word of her song, the more energy of mind she uses about it the more distant is she from regaining it, and artfully employs her mind in part on some other object, or endeavours to dull its perceptions by continuing to repeat, as it were unconsciously, the former part of the song that she remembers in hopes to gain the lost connection. For if the activity of the mind itself be more energetic, or takes its attention more than the connecting word which is wanted, it will not perceive the slighter link of this lost word, as who listens to a feebler sound must be very silent and motionless, so in this case the very vigour of the mind itself seems to prevent it from regaining the lost catenation."—*Dr. E. Darwin.* "In reciting, for instance, a passage of poetry from memory, there is generally better success from trusting to the mere mechanism of the faculty—to the unbidden flow of words—

But not only are there in the mind mental images of sensible objects, and of muscular movements, of what we feel and of what we do, but every thought, however abstract or apparently disconnected from sensible objects, has it image in the mind. We can only conceive an abstraction by having an image of it. The abstract idea of a triangle, which is not any particular triangle but represents the properties common to all triangles, has as much its image in the mind as any individual triangle that may have been before it. Further, we must regard each abstract idea as having a physical state corresponding to it; and hence we can localise abstract ideas, and recall the occasions when they were present.

It is as serving to guide and direct our various activities that mental images derive their chief value and importance. In anything that we purpose or intend to do, we must first of all have an idea or image of it in the mind, and the more clear and correct

than from any effort to guide it by thought or suggestion."—*Sir H. Holland.* "It is notorious that in games of skill any lengthened consideration or active interference on the part of the higher faculties almost invariably causes a failure. The direct guidance that has been established between the constituent sensations and the constituent motions must be allowed free play; and success becomes sure in proportion as by constant co-ordination the combined changes become practically one change."—*H. Spencer.* "In playing by memory on a musical instrument, the muscular sense often suggests the sequence of movements with more certainty than the auditory."—*Dr. Carpenter.* We are told of a celebrated teacher of drawing in Paris, who was very successful with his pupils, that he made them study the models thoroughly before they tried to draw them. One favourite expedient was to make them follow, at a distance, the outlines of the figure with a pencil held in their hands, and then draw them from memory. Colonel Moncrieff mentioned a North American Indian coming to see him, and "tracing the outline of a print from the *Illustrated News* very carefully with the point of his knife. The reason he gave for this odd manœuvre was that he would remember the better how to carve it when he returned home."—*F. Galton.*

the image, the more accurately and efficiently will the purpose be carried out. We cannot exert an act of volition without having in the mind an idea or image of what we will to effect.[1] The will has no direct power over the muscles but only over the images in the mind, and it is in accordance with these that the muscles act.[2] By suggesting ideas to the mind of the mesmerised subject he may be made to do the most absurd things. It is well known, too, in the treatment of the insane that if a patient is violent from the presence of a particular idea in the mind, the introduction of a new idea by a well-directed question or otherwise will often at once change the current of his thoughts, and so allay his excitement.[3]

Clearness and accuracy of image is only to be obtained by repeatedly having it in the mind, or by repeated action of the faculty. Each repeated act of any of the

[1] "It is certain that in order to execute consciously a voluntary act we must have in the mind a conception of the aim or purpose of the act."—*Dr. Maudsley.*

[2] "The will which carries into action the determinations of the intellect has no direct power over the muscles which execute its mandates."—*Dr. Carpenter.* "Our power of willing consists in the power of calling into existence the appropriate idea. . . . The power of the will is not immediate over the muscle but over the idea. . . . Whenever we have obtained a command over the ideas, we have also obtained a command over the motions," and "we cannot perform associated contractions of several muscles till we have established by repetition the ready association of the ideas".—*James Mill.*

[3] "The insane impulse appears to be not unfrequently the expression of a dominant idea . . . which operates by taking full possession of the mind, and by forcing the body (so to speak) into the movements which express it. . . . Of all the features of insanity, morbid impulses, emotions and feelings, and the loss of control over them, are the most essential and constant."—*Dr. Carpenter.* The late Prof. Traill, of Edinburgh, was on one occasion in the room with a madman, who suddenly locked the door and threatened to throw him out of the window. "I can do better than that," said the Professor, "I can go down to the street and jump in at the window." The extravagance of this boast gave a new turn to his thoughts; he opened the door to allow the Professor to go down to the street, and was at once secured.

faculties renders the mental image of it more clear and accurate than the preceding, and in proportion to the clearness and accuracy of the image will the act itself be performed easily, readily, skilfully. The course to be pursued, the point to be gained, the amount of effort to be put forth, become more and more clear to the mind. It is only from what we have done that we are able to judge of what we can do, and understand how it is to be effected.[1] When our ideas or conceptions of what we can do are not based on experience, they become fruitful sources of error.

A clear and accurate idea of what we wish to do, and how it is to be effected, is of the utmost value and importance in all the affairs of life.[2] A man's conduct naturally shapes itself according to the ideas in his mind, and nothing contributes more to success in life than having a high ideal and keeping it constantly in view.[3] Where such is the case one can hardly fail in attaining it. Numerous unexpected circumstances will be found to conspire to bring it about, and even what

[1] "We cannot do an act voluntarily unless we know what we are going to do, and we cannot know exactly what we are going to do until we have taught ourselves to do it."—*Dr. Maudsley.*

[2] "By aiming at a new construction, we must clearly conceive what is aimed at. . . . Where we have a very distinct and intelligible model before us we are in a fair way to succeed; in proportion as the ideal is dim and wavering we stagger and miscarry." —*Prof. Bain.*

[3] "The continued concentration of attention upon a certain idea gives it a dominant power, not only over the mind but over the body."—*Dr. Carpenter.* "The idea of our own strength gives strength to our movements. A person who is confident of effecting anything by muscular efforts will do it more easily than one not so confident in his own power."—*Dr. J. Müller.* "The entire man in his body and soul, his actions and moral feelings, is governed by what he believes."—*Anon.* "To believe firmly is almost tantamount in the end to accomplishment. Extraordinary instances are related showing the influence of the will over even the involuntary muscles."—*Dr. Tanner.*

seemed at first to be hostile may be converted into means for its furtherance; while by having it constantly before the mind he will be ever ready to take advantage of any favouring circumstances that may present themselves.[1] "A passionate desire and an unwearied will can perform impossibilities, or what seem to be such, to the cold and feeble."—*Sir J. Y. Simpson.* "Dream, O youth, dream manfully and nobly, and thy dreams shall be prophets."—*Lord Lytton.*[2]

But in order properly to understand the importance of these images, and to perceive the power and extent of their influence, it is necessary to keep in view that much that exists in the mind, and exerts an influence in it, does so unconsciously, as will be shown at greater length in the next chapter. While a mental image must first have been consciously in the mind before we could afterwards recognise it as having been there at all, yet after a time, or after many returns, it may be in the mind, and exert an active influence there without our being conscious of its presence.[3] Time is a necessary element in consciousness, and an idea or image

[1] "It is wonderful how even the casualties of life seem to bow to a spirit that will not bow to them, and yield to subserve a design which they may, in their first apparent tendency, threaten to frustrate. . . . When a firm decisive spirit is recognised it is curious to see how the space clears around a man and leaves him room and freedom."—*John Foster.*

[2] "Thus it is that aspirations are often prophecies, the harbingers of what a man shall be in a condition to perform."—*Dr. Maudsley.* It is related of Warren Hastings that when only seven years old "there rose on his mind a scheme which through all the turns of his eventful life was never abandoned. He would recover the estate which belonged to his father—he would be Hastings of Dalyesford." *T. B. Macaulay.*

[3] "An idea sometimes arises and produces a movement without there having been any active consciousness of it, the effect being that which first arouses consciousness if it be aroused at all.—*Dr. H Maudsley.*

must be a certain time before the mind in order to its being consciously apprehended. But the more frequently ideas recur, and the more familiar they become, the less time do they occupy, and the less impression do they make,—coming and going, frequently, without our being at all aware of it. We only know of their presence from the effects they produce, or the results that follow from them. In learning to play on the piano, for instance, one is at first fully conscious of every note as he goes over it; but after a lengthened practice he may be able to play the most difficult pieces without giving any attention to them, carrying on, perhaps, an animated conversation on an entirely different subject at the same time. There is every reason to believe that mental images were present in the latter case as in the former, guiding and directing every step of it, but their passage through the mind was too rapid for them to be taken notice of. Sometimes an unconscious idea will prevail over a conscious one, and one may purpose or intend to do a certain thing, or to follow out a certain line of conduct, but other influences, the result of previous actions, may prevail, and what he would he does not, and what he would not that he does.[1] In the same way a man may wish to give expression to certain thoughts in his mind and yet, from the presence of different or perverted images, he may say or write something different or even contrary to what he intended.

[1] "In certain individuals and in a certain state of mental concentration the expectation of a result is sufficient to determine, without any voluntary effort and even in opposition to the will, the muscular movements by which it is produced."—*Dr. Carpenter.* "Everyone's experience will recall to him occasions on which an idea excited in his mind could not be dismissed therefrom by the will, and perhaps would not let him rest until he had realised it in action, even though such realisation appeared to his judgment inadvisable."—*Dr. H. Maudsley.*

Perhaps something like the following may have at some time or other occurred to most of our readers:—He wishes to write a letter, has paper and pens before him, but wants ink. He knows he wants something, and paper being before him puts the idea of paper into his mind, and he says, "Bring me some paper" instead of ink. We believe that telegraph-offices are not without instances of clerks sending messages very different from, if not directly contrary to, what was before them. The message probably suggested to the mind ideas of the contrary, and the latter were accordingly sent.[1]

If we bear in mind that every sensation or idea must form an image in the mind before it can be perceived or understood, and that every act of volition is preceded by its image, it will be seen that images play a very important part in all our mental operations. According to the nature of the ideas or images which he entertains will be the character and conduct of the man. The man tenacious of purpose is the man who holds tenaciously certain ideas; the flighty man is he who cannot keep one idea before him for any length of time, but

[1] "Ideas which have passed out of the conscious memory sometimes express themselves in involuntary muscular movements to the great surprise of the individual executing them."—*Dr. Carpenter.* In certain forms of mental insanity "we find a sort of duplication of the mental unity. The individual thus divided into two parts—one portion of himself remaining healthy while the other is at the mercy of the phenomena of automatic involuntary impulse—looks on as a conscious spectator at certain extravagant acts that he is forced to commit, at certain senseless words that he utters. . . . There are patients sometimes who write and describe their distresses—the involuntary agonies through which they pass, the words they have pronounced unwittingly, how they are impelled to speak in spite of themselves, to say what they would not have wished to say, to go through ridiculous gesticulations, and to commit extravagances they believe themselves incapable of restraining."—*J. Luys.* "When anyone is thinking intensely about one thing and carelessly conversing about another, he is liable to use the word of a contrary meaning to that which he designed, as cold weather for hot weather, summer for winter."—*Dr. E. Darwin.*

constantly flits from one to another; the insane man is he who entertains insane ideas often, it may be, on only one or two subjects.

We may distinguish two great classes of individuals according to the prevailing character of their images. They are those in whose mind sensory images predominate, and those whose images are chiefly such as tend to action. Those of the former class are observant, often thoughtful, men of judgment, and, it may be, of learning; but if they have not also the active faculty in due force, they will fail in giving forth or in turning to proper account their knowledge or learning, and instances of this are by no means uncommon. The man, on the other hand, who has ever in his mind images of things to be done, is the man of action and enterprise. If he is not also an observant and thoughtful man, if his mind is backward in forming images of what is presented to it from without, he will be constantly liable to make mistakes. We sometimes meet with persons whose minds are so taken up with something or other to be done, that they pay little heed to any impressions they may receive from things around them. They are careless and unobservant of these things. There are persons whose minds are so filled with what they themselves have to say, that they can scarcely give a moment's thought or attention to what anyone else may have to say in return.[1]

Many of the peculiarities that are to be met with in abnormal conditions of the mind are, in our opinion, to be attributed to defects in the power of image-formation, or to the loss of it in certain directions. The presence

[1] "To some men and women the incessant exercise of speech seems to be no less necessary than the function of respiration; and to such persons, while indulging this uncontrollable propensity, the entertainment of their hearers is not at all an object."—*D. Stewart.*

of a mental image being necessary to an act of volition, if the mental image is lost or cannot be recalled, the voluntary action will fail to be performed. This would seem to be what really takes place in certain kinds of paralysis (*Locomotor Ataxia*), in which the motor power is intact, while the sense of feeling is lost, and with it the power of motion, unless sight or touch comes to form an image of the parts in the mind.[1] It is a well-known fact that a patient of this kind who has lost the use of his legs may yet be able to walk if he keep his eyes fixed upon them, and so convey an image of them to the mind; and in like manner a mother who has lost the use of her arms is able to hold her child as long and no longer than her eyes are centred on them.[2] It is

[1] "In hemiphlegia, the patient may will to move to the utmost, yet no motion follows."—*Dr. Laycock.* "When sensation is lost, so is motor power; when sensation is restored, motor power returns along with it. The want of sensibility and the want of motor power not only come and go together, but they are confined to the same part of the body, thus apparently showing that they are inseparably interlinked."—*Dr. J. Cunningham.* "As soon as the patients take their eyes off their limbs, they have no more consciousness of their position or even of their existence. When in bed they lose them as it were, and are obliged to look for them, not knowing where they are. Sometimes they try to stretch out or bend some limb already stretched out or bent. On moving, they are ignorant of the extent of their movement, and frequently do not know whether they have moved or not. If they intend to move, but are prevented, they are unaware of it, and think they have moved from having willed to do so."—*H. Taine.*

[2] "A woman who had suffered complete loss of sensation in one arm, but who retained its motor power, found that she could not support her infant upon it without constantly looking at the child; and that if she were to remove her eyes for a moment, the child would fall, in spite of her knowledge that her infant was resting upon her arm, and of her desire to sustain it. Here the muscular sense being entirely deficient, the sense of vision supplied what was required so long as it was exercised upon the object; but as soon as this guiding influence was withdrawn, the strongest will could not sustain the muscular contraction."—*Dr. Carpenter.* "Sir Astley (Cooper) cited to me the case of a man completely deprived of the

evident that the eye can do nothing towards communicating sensibility to the part affected. It can only supply the mind with an image of the affected limb, and of the movements it is desired to effect; which would go to prove that it is the mental image, and not merely muscular sensibility, that directed the movement, —that in the normal state, it is the mental image derived from muscular sensibility that guides the movements.[1]

In *Aphasia*, or loss or impairment of the faculty of speech, there is no paralysis of the organs of the voice. It is owing to a mental defect arising, we believe, from inability to form in the mind the motor images necessary to speech. There is no impairment of power or control over the muscles of the voice; they may even be able to repeat the words spoken by another, but they are unable of themselves to recall the ideas or images that are necessary to vocal expression. "If," says M. Ribot, "we adopt the theory that the amnesia of signs (aphasia) is a disease of the motor memory, we discover at once its distinguishing characteristic, and are able to study the subject from a new point of view."[2] In what is known as "hysterical paralysis,"

faculty of sensation in one arm and hand, the muscular power of which was, however, preserved. When this man was desired to take hold of and to lift anything, he did so quite well; but if, whilst holding the object, his attention was taken away from the hand, irregular contractions of the limb commenced, and very soon the object fell to the ground; as soon as the patient ceased to follow the contractions of his fingers with his eyes, nothing remained to inform him that he held the object when, of course, it escaped from his grasp."—*Dr. Solly.*

[1] "The difference between an involuntary movement of the leg and a voluntary one is that whereas the involuntary one takes place without any previous consciousness of the movements to be made, the voluntary one takes place only after it has been represented in consciousness."—*H. Spencer.*

[2] Movements "which are employed in articulate speech, writing, drawing, music, gestures, can only be conserved and reproduced on

there is no imperfection of muscle or nerve, but simply absence of all desire to will—absence of the images necessary to voluntary action.[1] The like holds true with regard to what is called "psychical blindness," where there is no imperfection of the organs of vision, but simply the inability to form an intelligible image of the visual impression received.[2]

Loss of memory, again, which is a frequent attendant of paralysis, is also to be attributed to inability to form or recall mental images; and the remarkable thing here is, that it will affect certain classes of images and not others, thus going to prove what has already been pointed out, that different kinds of memory have different seats.[3] Thus a man forgets

the condition that there are motor residua. It is clear that if nothing remained of a word uttered or written for the first time it would be impossible to learn to speak or write. . . . We are able to speak with facility our own or a foreign tongue where these (vocal) movements are easily reproduced—that is to say, when the motor residua are organised."—*Th. Ribot.*

[1] In hysterical paralysis "there is no imperfection of muscle, nerve, or kinetic substrata, but simply an absence of all desire to will. . . . An organism may conceivably desire to be happy but may not desire to act to attain the desirable state".—*Dr. Laycock.* "The want not really of power to move but of a belief in the possession of that power is the characteristic of the peculiar form of paralysis which is commonly designated as 'hysterical'; and the most efficacious treatment of this remarkable disorder is to work the patient up to the conviction that the ability has been or will be restored. . . . And such is the manner in which similar marvels have been brought about by any *modus operandi* whatever which begets in the mind of the 'subject' a confidence that the thing hitherto deemed impossible *can* be accomplished, and concentrates all the mental and physical powers on the effort to perform it."—*Dr. Carpenter.*

[2] "Muntz has put forth the important distinction that there may be blindness in the sense of total deprivation of vision and 'psychical blindness,' or the inability to form an intelligent comprehension of the visual impressions received."—*Prof. M'Kendrick.*

[3] "A stroke of the palsy has been known (while it did not destroy the power of speech) to render the patient incapable of recollecting

the words with which to express his ideas, though he knows very well what he wishes to say, and knows when it is said by another. He may know very well what is said to him, but be unable to put in words what he wishes to say; or he may fail to understand what is said to him orally, but be able to follow it at once when written or printed; or, conversely, the written word may not be understood, while he readily comprehends what is spoken. Some know a thing when they hear it named, but are unable to name it, or they can give all the letters of a word, and yet be unable to pronounce it. One could write distinctly to dictation but could not read a moment afterwards what he had written. Some can name objects when they are set before them, but are unable to do so when they are withdrawn. The memory for names may be lost, while the memory for things remain; and one may know his friends perfectly and yet be unable to name them.[1] These and similar

the names of the most familiar objects. What is still more remarkable, the name of an object has been known to suggest the idea of it as formerly, although the sight of the object ceased to suggest the name."—*D. Stewart.* "There are individuals who having suffered from disease of the brain are unable to express their thoughts by speech although, their faculties being little or not at all impaired otherwise, they have a perfect comprehension of what others say and of what they wish to say themselves."—*Sir B. Brodie.* "The loss of the memory of words . . . is a special disorder which not unfrequently presents itself—the patient understanding perfectly well what is said, but being unable to reply in any other terms than *yes* or *no* or by affirmative or negative gestures; not from any paralysis of the muscles of articulation, but from incapability of expressing the ideas in language."—*Dr. Carpenter.*

[1] "The memory of only a particular class of words such as nouns or verbs may be lost; or the patient may remember the letters of which a word is composed, and may be able to spell his wants though he cannot speak the word itself,—asking for bread, for example, by the separate letters b, r, e, a, d. A very curious affection of the memory is that in which the *sound* of spoken words does not convey any idea to the mind, yet the individual may recognise in a written or

phenomena become intelligible when we connect them with the disappearance from the mind of certain classes of images—visual, auditory, or vocal.

Sometimes words or names are used wrongly, but always in the same sense, as if the images had got out of their proper places. Thus Mr. A. may always be called Mr. B., and Mr. B., Mr. A.; paper may be called coals and coals paper.[1] Sir B. Brodie gives the case of a gentleman who, having had a stroke of apoplexy, "lost the power not only of expressing himself in intelligible language, but also of comprehending what was said to him by others. He spoke what might be called *gibberish*, and it seemed to him that his friends spoke *gibberish* in return. But while his memory as to oral language was thus affected, as to written language it was not affected at all. If a letter was read to him it conveyed no ideas to his mind, but when he had it in his own hand and read it himself he understood it perfectly." In this case we may be said to have an instance of double dislocation, two classes of images having got displaced. The sounds he heard no longer gave rise to their proper images in his mind—those, namely, with which they were formerly associated—but to others of a different kind, which conveyed no intelligible meaning to him. In addition to this, the images of his vocal

printed list of words those which have been uttered by the speaker, the *sight* of them enabling him to understand their meaning. Conversely, the sound of the word may be remembered and the idea it conveys fully appreciated, but the visual memory of its written form may be altogether lost, although the component letters may be recognised."—*Dr. Carpenter.*

[1] "Occasionally patients have forgotten the signification of words and designated the thing by a term which has not the least connection with it. Generally speaking, the patients are quite aware that they are using a wrong word, for often if we suggest the term intended they immediately recognise it and rejoice at having recovered it."—*Prof. van der Kolk.*

utterances had been displaced, and when he gave expression to those that were in his mind, they were destitute of meaning to others.

It is with these mental images, then, that the memory has more particularly and directly to do. It is these that it treasures up and recalls, and it is upon the nature and character of the image which is formed in the mind that the power of the memory to reproduce it depends. When the image is clear, distinct, and vivid, it is readily reproduced with much of its original character and force; but when, on the other hand, it is indistinct, hazy, ill-formed, it will be recalled, with difficulty, and only in a very imperfect manner. The image which is recalled may be of any degree of clearness and completeness, from the most distinct and perfect, scarcely to be distinguished from the original impression, to the most indistinct and fragmentary, bearing but little resemblance to the original. When the image has disappeared and cannot be recalled the memory of it is gone. The defects of memory of which most persons complain are usually to be attributed to imperfectly formed and indistinct images. If sufficient time and attention are not bestowed upon the original impression, the image that is formed of it in the mind and stored up in the memory will be indistinct and imperfect, and correspondingly difficult of recall. The great means, then, for strengthening and improving the memory are such as tend to the formation of clear and distinct images in the mind.

We are usually told that all memory is association, and that if we wish to fix a thing in the memory we must associate it with something that is in the mind already. It is upon this principle that all systems of mnemonics are constructed. Association, as we shall

see, has its place and work in regard to memory, but it is not upon it that the memory itself mainly rests. Association is merely the means by which what is in the memory is recalled and brought again before consciousness. But the subject-matter of memory, that which is treasured up and recalled, is the image which has been formed in the mind; and unless this is clear and accurate, that which is recalled will in like manner be defective. In order, then, to a good memory—one that will bring the past clearly and accurately before us—we must attend to the formation of the images in the mind, and see that they clearly and accurately represent the original sensations or ideas. In other words, in order to remember well we must observe well and with attention.

A main point in all education should be the formation of clear and distinct images in the mind. We cannot think clearly, or express ourselves clearly, unless we have clear images in the mind. It is not necessary to understand a thing in order to form a clear image of it. In fact sometimes things not understood are most clearly imaged in the mind. Our earliest, clearest, and most lasting images are those that come to us through the senses; and hence the training of the senses to form clear and accurate images of things is principally to be considered in the improvement of the memory. The great advantage of object-lessons to children springs from this, that they present to the mind sensible images of the instruction which is communicated. Hence, too, the advantage of pictures, plans, and maps in imparting clear ideas, and in fixing them in the memory. In the case of any subject capable of illustration a visible representation of it will greatly help the mind in imaging and in remembering

it.[1] It is to be regretted that bits of science, bits of natural history, bits of mechanics, which can take but little hold on the imagination of a child, should occupy so large a space in our elementary school books in place of fables, fairy tales, stories of daring, and romance, which call out the imagination of the child and make a lasting impression on the memory.[2] Speaking of the visualising faculty, Mr. F. Galton says: "Our bookish and wordy education tends to repress this valuable gift of nature. A faculty that is of importance in all technical and artistic occupations, that gives accuracy to our perceptions and justness to our generalisations, is starved by lazy disuse, instead of being cultivated judiciously in such a way as will on the whole bring the best return. I believe that a serious study of the best method of developing and utilising this faculty without prejudice to the practice of abstract thought in

[1] "A few dots like those used by the bushmen give great assistance in creating an imaginary picture, as proved by our general habit of working out ideas by the help of marks and rude lines."—*F. Galton.*

[2] "The modern practice of occupying the minds of children with the reasons of things, *i.e.*, with laws, principles, &c., in the form of compends of astronomy, natural or mental philosophy, natural theology, &c., is one that cannot be too earnestly deprecated."—*N. Porter.* "It is probable that fables, parables, similes, allegory, &c., please, strike, and instruct, chiefly on account of the visible imagery which they raise up in the fancy. They are also the more easily remembered on the same account."—*Dr. Hartley.* "Of all people children are the most imaginative. Every image which is strongly presented to their mental eye produces on them the effect of reality." —*Lord Macaulay.* "I have often maintained that fiction may be much more instructive than real history."—*John Foster.* "The world may rely upon it that catechisms, whether Pinnock's or the Church of England, will be found a poor substitute for those old romances, whether of chivalry or of faëry, which, if they did not give a true picture of actual life, did not give a false one, since they did not profess to give any, but (what was much better) filled the youthful imagination with pictures of heroic men, and of what are at least as much wanted, heroic women."—*J. S. Mill.*

symbols is one of the many pressing desiderata in the yet unformed science of education."[1] But the faculty of forming mental images is not confined to the eye. It extends to all of the other senses, to all our voluntary movements, and to every subject of thought; and therefore the importance of cultivating it in all these directions is so much the greater.

The natural course of our knowledge is from the general to the particular. Our first impression of an object is a general one, but as we contemplate it we pass in review its several parts successively before the mind and thus obtain a clear idea of the whole. In gazing on a landscape, for instance, we first of all get a general impression of it, but this will be very crude and imperfect unless we come down to particulars and concentrate the attention successively upon its different parts.[2]

In order to form a clear and distinct image of an object in the mind, it is usually necessary to analyse it and to concentrate the attention upon its different parts one by one. (See "Attention," Chapter VII.)

[1] "There can be no doubt as to the utility of the visualising faculty where it is duly subordinated to the higher intellectual operations. A visual image is the most perfect form of mental representation wherever the shape, position, and relations of objects in space are concerned. It is of importance in every handicraft and profession where design is required. The best workmen are those who visualise the whole of what they propose to do before they take a tool in their hands."—*F. Galton.*

[2] "When we wish to make ourselves thoroughly acquainted with a landscape or a picture, we intentionally direct the axes of our eyes to each particular part of it successively, and study that part in its details, until we have formed a composite conception of the whole."—*Dr. Carpenter.*

CHAPTER VI.

MIND, CONSCIOUS AND UNCONSCIOUS.

"The teaching of most modern psychologists is that consciousness forms but a small item in the total of psychical processes. Unconscious sensations, ideas, and judgments are made to play a great part in their explanations. It is very certain that in every conscious volition—every act that is so characterised—the larger part of it is quite unconscious. It is equally certain that in every perception there are unconscious processes of reproduction and inference,—there is . . . a middle distance of sub-consciousness, and a 'background' of unconsciousness."—*G. H. Lewes.*

"I do not hesitate to affirm that what we are conscious of is constructed out of what we are not conscious of—that our whole knowledge in fact is made up of the unknown and the incognisable." The sphere of our consciousness is "only a small circle in the centre of a far wider sphere of action and passion, of which we are only conscious through its effects".—*Sir W. Hamilton.*

"Mental events imperceptible to consciousness . . . are far more numerous than the others, and of the world which makes up our being we only perceive the highest points—the lighted up peaks of a continent whose lower levels remain in the shade. Beneath ordinary sensations are their components, that is to say, the elementary sensations, which must be combined into groups to reach our consciousness. . . . Outside a little luminous circle lies a large ring of twilight, and beyond this an indefinite night; but the events of this twilight and this night are as real as those within the luminous circle."—*H. Taine.*

"Examine closely, and without bias, the ordinary mental operations of daily life, and you will surely discover that consciousness has not one tenth part of the function therein which it is commonly assumed to have. . . . In every conscious state there are at work conscious, sub-conscious, and infra-conscious energies, the last as indispensable as the first."—*Dr. Maudsley.*

"Memory is a faculty not only of our conscious states, but also, and much more so, of our unconscious ones."—*Dr. E. Hering.*

IT is impossible to understand the true nature of memory, or how to train it aright, unless we have a clear conception of the fact that there is much in the mind of which we are unconscious. Formerly consciousness was regarded as being co-extensive with mind—the mind being held to be conscious of all its own activities, of all the changes

or modifications that take place in it. Leibnitz was the first to confute this opinion, and to establish the doctrine that there are energies always at work, and modifications constantly taking place in the mind, of which we are quite unconscious.[1] Since his time this opinion has been gradually gaining ground, and now it is a generally received doctrine in philosophy.[2]

Consciousness, or the internal sense, which reveals to us what exists or is taking place in the mind, is, like the external senses, which take cognisance of outer objects, limited in its sphere of operation. We cannot by means of the bodily senses take cognisance of all that exists in the physical world, nor can we by consciousness comprehend all that is taking place in the mind. "Consciousness," says H. Taine, "is no more sufficient in psychological inquiries than the naked eye in optical inquiries." "Could we magnify the discerning power of consciousness as we can magnify the power of vision by the microscope, we might enable consciousness to extend its cognisance to modifications

[1] "The psychologists of Germany, from the time of Leibnitz, have taught that much of our mental work is done without consciousness."—*Dr. Carpenter.* "To this great philosopher belongs the honour of having originated this opinion, and of having supplied some of the strongest arguments in its support."—*Sir W. Hamilton.* "D'ailleurs il y a mille marques qui font juger qu'il y a à tout moment une infinité de perceptions en nous, mais sans Apperception et sans Réflexion, c'est à dire des changements dans l'Ame même, dont nous ne nous appercevons pas, parce que ces impressions sont ou trop petites et en trop grand nombre, ou trop unies en sortes qu'elles n'ont rien d'assez distinguant à part mais jointes a d'autres, elles ne laissent pas de faire léur effèt et de se faire sentir dans l'assemblage ou moins confusément."—*Leibnitz.*

[2] "The fact of such latent mental modifications is now established qeyond a rational doubt; and, on the supposition of their reality, we are able to solve various psychological phenomena otherwise inexplicable."—*Sir W. Hamilton.*

twice, ten times, ten thousand times less than it is now competent to apprehend."—*Sir W. Hamilton.*[1]

In order to consciousness the mind requires to be in a state of activity. "In so far as we are conscious," says Sir W. Hamilton, "we are active. . . We are never directly conscious of passivity." Further, "Consciousness exists only in virtue of a change from one state or condition of mind to another, by the occurrence of a state unlike the previous state, and can continue only so long as the change continues".—*H. Spencer.*[2] "We may fairly presume that when all the currents of the brain are in a balanced condition, when no one is commencing, increasing, or abating, consciousness or feeling is null, mind is quiescent. A disturbance at any point wakens up consciousness for the time, a second disturbance continues it from another point, and so on,—the variety of stimulus in the waking state forbidding the perfect equilibrium of the mind."—*Prof. Bain.* Thus continuance of the same state of mind is opposed to consciousness, for it is possible for a man to think on a subject till he ceases to be conscious of it, as he may gaze on an object till the eye becomes blind.[3] Hence

[1] There is no good reason "for doubting that, if our powers of attention and memory were more perfect than they are, so as to give us the same advantage in examining rapid events which the microscope gives for examining minute portions of extension, they would enlarge our views with respect to the intellectual world no less than that instrument has with respect to the material".—*D. Stewart.*

[2] "We are only conscious as we are conscious of a determinate state or mental modification, the existence of which supposes a change or transition from some other state or modification."—*Sir W. Hamilton.*

[3] "The very condition on which only consciousness exists is perpetual change; . . . a truth illustrated by the fact that when, as under intense agony, the sensation ultimately becomes strong enough totally to exclude all thought, totally to absorb consciousness—consciousness ceases; the patient faints."—*H. Spencer.*

the evil of allowing the mind to dwell too long on any one subject. There must be change and variety in order to clearness and vigour of thought.

It is owing to the effort, or the resistance, put forth by the *Ego* against whatever is opposed to it that consciousness exists. "Consciousness," says Prof. Ferrier, "is an act of antagonism put forth against whatsoever state or modification of humanity it comes in contact with." "The impression we call resistance is the primordial, the universal, the ever-present constituent of consciousness."—*H. Spencer.* Did complete and perfect harmony exist between the *Ego* and the *Non-Ego*—the world within and the world without—no jarring, no struggle, no resistance, consciousness as we now know it could have no existence.[1] Hence, there have not been wanting those who have regarded consciousness as an evil or defect of our nature.[2]

The degree or strength of our consciousness "always exists in an inverse ratio to the degree of intensity of any of our sensations, passions, emotions," &c.; and "consciousness is never so effectually depressed, or

[1] "Were there an entire and perfect fitness of relations between the *Ego* and the *Non-Ego*, a complete certitude in every respect, a full and exact harmony, consciousness would be extinguished."—*Dr. Maudsley.* "Know ye not that ye are what ye are only on account of the antagonism between you and it (*i.e.*, the external world); that ye perceive things only by resisting their impressions, by denying them, not in word only, but also in vital deed; that your refusal to be acted upon by them constitutes your very personality, and your very perception of them."—*Prof. Ferrier.*

[2] "Many besides Schopenhauer have secretly regarded consciousness as the hideous mistake and malady of nature."—*Prof. Drummond.* "Children are, by learned men, said to be long ignorant of the *Ego*—blessed in many respects by their ignorance! This same *Ego*, as it now exists, being perhaps part of the fruit of that forbidden tree,—that mere knowledge of good as well as of evil which our great mother bought for us at such a price."—*Dr. John Brown.*

perhaps we may say, never so totally obliterated within us, as when we are highly transported by the vividness of any sensation, or absorbed in the violence of any passion; while, on the other hand, returning consciousness, or increasing self-reference, has always the effect of deadening the sensation and suspending the passion, until at length, when it reaches its ultimatum, the sensation or passion becomes totally extinct".—*Prof. Ferrier.*[1]

A sensation, thought, or motion requires to be of a certain magnitude or intensity, and to persist before the mind for a certain time, in order to our being conscious of it.[2] The mind is constantly receiving impressions, thoughts are incessantly passing through it that are unperceived, because they are not of sufficient magnitude or intensity to make themselves felt.[3] In like manner,

[1] "When passion or any state of mind, at the one pole, is at its *maximum*, consciousness is at its *minimum*, this maximum being sometimes so great as absolutely to extinguish consciousness while it continues; and *vice versa*, when consciousness is at its *maximum*, the passion, or whatever the state of mind at the opposite pole may be, is at its *minimum*, the maximum being in this case, too, sometimes so great as to amount to a total suspension of the passion," &c.—*Prof. Ferrier.* "By a wise ordinance of nature our feelings have no abiding place in our memory; nay, the more vivid they are in the moment of their existence, the more dim and difficult to be remembered do they make the thoughts which accompanied them. Those of my readers who at any time of their life have been in the habit of reading novels may easily convince themselves of this truth by comparing their recollections of those stories which most excited their curiosity, and even painfully affected their feelings, with their recollections of the calm and meditative pathos of Shakespeare and Milton."—*S. T. Coleridge.*

[2] "If one of the conditions of consciousness is wanting, whether intensity or duration, or others of which we are ignorant, . . . consciousness disappears."—*Th. Ribot.*

[3] Many impressions "are either so faint in themselves, or so familiar, so submerged in stronger sensations, or so incapable of exciting trains of reflex feeling in the preoccupied mind, that we are neither conscious of them when present, nor capable of remembering them afterwards."—*G. H. Lewes.*

"a certain amount of time is necessary for an impression to be perceived," and "an essential condition of consciousness is wanting when the duration of the nervous process falls below this minimum".—*Th. Ribot.*[1] Thus, acts which are at first executed slowly, and with full consciousness, become gradually less and less perceptible as they gain in ease and rapidity by repetition, till they fall below the minimum necessary for consciousness, and become unconscious.[2] In this way impressions we have frequently received, thoughts we have often entertained, actions we have many times done, come to pass through the mind so rapidly, that we may cease to be conscious of them.

It is not to be supposed, however, that these unconscious impressions or thoughts exert no influence upon the mind. "There are thoughts," says O. W. Holmes, "that never emerge into consciousness, which yet make their influence felt among the perceptible mental currents, just as the unseen planets sway the movements of those that are watched and mapped by the astronomer."[3] In every case of perception there is an ultimate perceptible minimum, which if we conceive to

[1] "Some minimum of time must be admitted as the condition of consciousness; and as time is divisible *ad infinitum*, whatever minimum be taken there must be admitted to be beyond the cognisance of consciousness intervals of time in which, if mental agencies be performed, these will be latent to consciousness."—*Sir W. Hamilton.*

[2] "An act is first performed slowly and cautiously; by repetition we gain ease and rapidity,—that is, the nervous process which serves as a base, finding a path already marked out, moves more rapidly, until it gradually falls below the minimum necessary for consciousness."—*Th. Ribot.*

[3] "It is surprising how uncomfortable anyone may be made by the obscure notion of something which he ought to have said or done on some occasion, but did not say or do, and which he cannot for the life of him now remember."—*Dr. Maudsley.*

be divided into two, each half will be unperceived, but each contributes its part towards rendering the whole perceptible.[1] The rapidly revolving wheel, bearing the seven prismatic colours, presents to the eye only the appearance of white, though each separate colour must have contributed to produce that result. "A sensation indecomposible by consciousness, and apparently simple, is a compound of successive, simultaneous sensations which are themselves highly complex."—*H. Taine.*

The rapidity with which ideas which are familiar to us pass through the mind is truly marvellous. A mathematician can go through a long and intricate calculation so rapidly that only the result comes before consciousness, and yet there can be no doubt that each step of the process passed through the mind. "The rapidity of the succession of transactions in our dreams is almost inconceivable, insomuch that when we are awakened by the jarring of a door which is opened into our bedchamber we sometimes dream a whole history of thieves or fire in the very instant of wakening."—*Dr. E. Darwin.* According to Kant, as quoted by Sir W. Hamilton, "we can dream more in a minute than we can act during a day"; and "the great rapidity of the train of thought in sleep is one of the principal causes why we do not always recollect what we dream".

We are not immediately and directly conscious of

[1] "The *minimum* visible is the smallest expanse which can be seen. . . . If we divide this into two parts, neither half can by itself be an object of vision. . . . But it is evident that each half must of itself have produced in us a certain modification, real though unperceived."—*Sir W. Hamilton.* "Two (or more) successive sensations, which singly are insensible to consciousness, may, when combined, form a total sensation which consciousness perceives."—*H. Taine.*

what may be in the mind. Consciousness requires some time in order to apprehend what may be presented to it, and by the time it has apprehended it the idea or impression may have passed away and given place to something else. What we are conscious of, then, is not what is in the mind at the time, but what was there some time before, and is now matter of memory. "Consciousness," says Dr. Thomas Brown, "is not that faculty by which we become sensible of the feelings that are present to the mind, but that by which we remember the feelings that have recently passed through it." "The undeniable condition of consciousness," says Sir W. Hamilton, "is memory."[1] The time taken by consciousness to perceive an impression varies greatly in different individuals and under different circumstances, being longer in old age or when the mental faculties are impaired.

In order to consciousness an impression must be in connection with the nervous system, and reach the sensorium or seat of consciousness, which, according to Mr. Lewes, is not the brain alone, but extends to all the ganglionic centres throughout the body.[2] Impressions are being constantly received and changes effected in different parts of our bodies, of which we are un-

[1] "Before we can observe a modification (of mind) it is already altered. . . . It hence results that the phenomena can only be studied through its reminiscence."—*Sir W. Hamilton.*

[2] Mr. G. H. Lewes argues with great ability, and with seemingly irresistible cogency, in favour of the position that sensation or feeling—that is, consciousness—is a property of all nervous ganglia. "That every ganglionic excitement whatever (cerebral, spinal, sympathetic) gives birth to sensibility, seems a more likely supposition than that sensibility should attach to certain ganglia (those in the cerebrum) and be absent from others made up of exactly the same nervous elements. . . . We may contend for the sensibility of all the organs of the system that are in any way connected by nerves to nerve-centres."—*Prof. Bain.*

conscious, because they are not connected with nerves and nerve-centres. These changes constitute what has been called the organic memory, "which," says M. Ribot, "resembles the psychological in all but one point—the absence of consciousness".[1]

Consciousness, then, is not to be regarded as synonymous or coextensive with mind. To have an idea or an impression in the mind, and to be conscious of it, are not one and the same thing, for there are ideas and impressions constantly in the mind of which we are totally unconscious.[2]

We have already expressed the opinion that every impression we receive, every thought we think, as well as every action we do, causes some change in the material structure of our bodies, and that this change is permanent, forming an imperishable record of all that we have experienced, thought, or done in the past.[3] In like manner we believe that every impression or thought that has once been before consciousness remains ever after impressed in the mind.[4] It may

[1] "Psychical memory is nothing but the highest and most complex form of organic memory."—*Th. Ribot.*

[2] "Consciousness is not to be regarded as synonymous or as coextensive with mind. . . . It is not to be regarded as an essence, a fundamental property, of mind, but as a phenomenon having its own conditions of existence."—*Th. Ribot.* "Those who speak of mind and consciousness as coextensive, . . . and treat the notion of unconscious mind as a gross absurdity, should soberly explain where, during a particular conscious state, all the rest of the mind is; where, in fact, all that furniture beyond the particular piece then in use is stored."—*Dr. Maudsley.*

[3] "After both conscious sensation and perception have been extinguished, their material vestiges yet remain in our nervous system by way of a change in its molecular or atomic disposition, that enables the nerve substance to reproduce all the physical processes of the original sensation, and with these the corresponding psychical processes of sensation and perception."—*Dr. E. Hering.*

[4] "If every state of consciousness implies as an integral part a

never again come up before consciousness, but it will doubtless remain in that vast ultra-conscious region of the mind, unconsciously moulding and fashioning our subsequent thoughts and actions.

It is only a small part of what exists in the mind that we are at any time conscious of. There is always much that is known to be in the mind that exists in it unconsciously, and must be stored away somewhere. We may be able to recall it into consciousness when we wish to do so, but at other times the mind is unconscious of its existence. Further, everyone's experience must tell him that there is much in his mind that he cannot always recall when he may wish to do so,—much that he can recover only after a laboured search, or that he may search for in vain at the time, but which may occur to him afterwards when perhaps he is not thinking about it.[1] Again, much that we probably would never be able to recall, or that would not recur to us under ordinary circumstances, we may remember to have had in the mind when it is mentioned to us by others. In such a case there must still have remained some trace or scintilla of it in the mind before we could recognise it as having been there before.

nervous action, and if this action produces a permanent modification of the nervous centres, the state of consciousness will also be recorded in the same place and manner."—*Th. Ribot.* "We have every reason to believe that mental power when once called forth follows the analogy of everything we see in the material universe in the fact of its perpetuity. . . . Every single effort of mind is a creation which can never go back again into nonentity. It may slumber in the depths of forgetfulness as light and heat slumber in the coal seams, but there it is, ready at the bidding of some appropriate stimulus to come again out of the darkness into the light of consciousness."—*J. D. Morell.*

[1] "That which has been long forgotten, nay, that which we have often in vain endeavoured to recollect, will sometimes, without any effort of ours, occur to us on a sudden, and, if I may so speak, of its own accord."—*Dr. Beattie.*

These cases occur in ordinary states of the mind, but in abnormal or exalted mental conditions we find still more remarkable instances. Thus in somnambulism, dreams, hysteria, the delirium of a fever, or on the approach of death, persons have been known to recall events of their past life, long since forgotten, and unable to be recalled under ordinary circumstances.[1] Persons in the delirium of a fever have been known to speak in a language which they had known in their childhood, but which for many years had passed from their memory; or to repeat with apparent accuracy discourses to which they had listened many years previously, but of which before the fever they had no recollection. They have even been known to repeat accurately long passages from books in foreign tongues, of which they never had any understanding, and had no recollection of in health, but which they had casually heard recited many years before.[2] The most remark-

[1] "The mind frequently contains whole systems of knowledge which, though in our normal state they have faded into absolute oblivion, may in certain abnormal states, as madness, febrile delirium, somnambulism, catalepsy, &c., flash out into luminous consciousness, and even throw into the shade of unconsciousness those other systems by which they had for a long period been eclipsed and even extinguished. For example, there are cases in which the extinct memory of whole languages was suddenly restored, and, what is even still more remarkable, in which the faculty was exhibited of accurately repeating in known or unknown tongues, passages which were never within the grasp of conscious memory in the normal state."—*Sir W. Hamilton.* "It is now fully established that a multitude of events which are so completely forgotten that no effort of the will can revive them, and that the statement of them calls up no reminiscences, may nevertheless be, so to speak, embedded in the memory, and may be reproduced with intense vividness under certain physical conditions."—*Mr. E. H. Lecky.*

[2] A case is related by S. T. Coleridge of a young woman of four or five and twenty who could neither read nor write, and who was seized with a nervous fever, during which she continued incessantly talking Latin, Greek, and Hebrew in very pompous tones, and with

able cases, however, are those of persons who have been resuscitated from drowning or hanging, and who have reported that they had a sudden revelation of all the events of their past life presented to them with the utmost minuteness and distinctness just before consciousness left them.[1] Sir Francis Beaufort, in describing his sensations when rescued from drowning, says that "every incident of his former life seemed to glance across his recollection in a retrograde succession, not in mere outline, but the picture being filled with every minute and collateral feature" forming "a kind of panoramic view of his entire existence, each act of it accompanied by a sense of right and wrong". "I have also been informed," says Sir B. Brodie, "of other instances of individuals whose minds have been affected very much in the same way, when they were suddenly placed in a situation which threatened imme-

a most distinct enunciation. Sheets of her ravings were taken down from her own mouth, and at last it was found that she had been for some years servant to a Protestant pastor, who was in the habit of walking up and down a passage of his house adjoining the kitchen, and reading aloud to himself portions of his favourite authors. In the books that had belonged to him were found many passages identical with those taken down from the girl's mouth.

[1] "It is affirmed of the drowning man that in the brief space of time which precedes unconsciousness, every event of his past life passes in rapid review before his eyes."—*Dr. M'Cosh.* "I was once told by a near relative of mine that having in her childhood fallen into a river and being on the very verge of death but for the assistance which reached her at the last critical moment, she saw in a moment her whole life clothed in its forgotten incidents, arranged before her as in a mirror, not successively, but simultaneously; and she had a faculty developed as suddenly for comprehending the whole and every part."—*T. De Quincey.* Dr. Abercrombie gives the case of a naval officer who fell overboard and was taken up in a state of suspended animation. "In giving an account of his feelings he stated his only distinct recollection to be, that in the act of drowning as it might correctly be called, the whole events of his past life were represented to him at the instant in the most clear and distinct manner."

diate death, although they were not at all deprived of their sensibility and self-possession."

There is, indeed, every reason to believe that there is no such thing with any of us as absolutely forgetting anything that has once been in the mind. "All mental activities, all acts of knowledge," says H. Schmid, as quoted by Sir W. Hamilton, "which have been once excited persist. . . . We never wholly lose them, but they become obscure. . . . The obscure cognition may exist simply out of consciousness, so that it can be recalled by a common act of reminiscence. Again, it may be impossible to recover it by an act of voluntary recollection; but some association may revivify it enough to make it flash after a long oblivion into consciousness. Further, it may be obscured so far that it can only be resuscitated by some morbid affection of the system; or, finally, it may be absolutely lost to us in this life, and destined only for our reminiscence in the life to come."

By adopting the opinion that every thought or impression that had once been consciously before the mind is ever afterwards retained, we obtain light on many obscure mental phenomena; and especially do we draw from it the conclusion of the perfectibility of the memory to an almost unlimited extent. We cannot doubt that, could we penetrate to the lowest depths of our mental nature, we should there find traces of every impression we have received, every thought we have entertained, and every act we have done throughout our past life, each one making its influence felt in the way of building up our present knowledge, or in guiding our everyday actions; and if they exist in the mind, might it not be possible to recall most if not all of them into consciousness when we wished to do so, if

our memories or powers of recollection were what they should be?[1]

Our judgment of things depends on our past experience, the particular instances of which we may be unable to recall, but which undoubtedly have their effect in determining the result at which we arrive. A merchant can test a piece of goods and declare its quality and value with the greatest accuracy from having previously examined numerous examples of the same kind, none of which may be consciously before the mind at the time, but many of which must have unconsciously aided him in coming to a decision. "What is termed 'common sense,'" says J. D. Morell, "is nothing but a substratum of experiences out of which our judgments flow, while the experiences themselves are hidden away in the unconscious depths of our intellectual nature;[2] and even the flow of public opinion is formed by ideas which lie tacitly in the national mind, and come into consciousness, generally, a long time after they have been really operating and shaping the course of events in human history."

One's present actions and thoughts depend more upon his previous thoughts and actions that he himself is aware of, or than is generally recognised.[3] We imagine that we ordain the direction of our thoughts, but may it not be that our thoughts merely go in the direc-

[1] "There is not a single act nor a single thought of our past life," says one, "that has not had an influence in fixing our present intellectual and moral condition."

[2] "Man's ordinary common sense is the resultant of the unconscious co-ordination of a long succession of small experiences mostly forgotten or perhaps never brought out into distinct consciousness." —*Dr. Carpenter.*

[3] "Every action is rigorously determined by the nature of the agent and the conditions under which the act takes place."—*G. H. Lewes.*

tion towards which they are unconsciously drawn, being swayed by the unconscious influence of past thoughts? so that in place of commanding our thoughts we are led by them, and simply follow in their wake. "I imagine," says M. Luys, "that I think of an object by a spontaneous effort of my mind; it is an illusion. . . . I obey when I think I am commanding, merely turning in a direction towards which I am unconsciously drawn." A man fancies he is free and can act in this way or that as he pleases, but others who know him and have studied his character are usually better able to determine how the man will be likely to act under given circumstances than the man himself.[1] If all the elements that go to form a man's character could be taken into account and duly estimated, we believe that his conduct in any particular case could be infallibly predicted. "Ever since men lived in society they have been in the habit of predicting the future conduct of each other from the past. . . . Men are perpetually staking pleasure, and fortune, and reputation, and even life itself, on the very principle (of necessity) that they speculatively reject."—*S. Bailey.*

If every thought or impression that has once been consciously before the mind is ever afterwards retained, it will retain along with it all those thoughts or impressions with which at any time it has been associated. Thus the words "man," "horse," "child," will come in time to be associated with an immense number of men, horses, children, and that some rather than others come before the mind on any particular occasion will depend on a variety of circumstances, more particularly on the

[1] "Les hommes se trompent en ce point qu'ils pensent être libres. Or en quoi consiste une telle opinion? En cela seulement, qu'ils ont conscience de leurs actions et ignorent les causes qui les déterminent."—*Spinoza.*

particular frame of mind or train of thought at the time.[1] Thus every phase of thought finds its appropriate expression, and a man is able to clothe his ideas in suitable language without any conscious effort or recognised act of judgment. The exact words that serve to express his ideas come up selected from a host of others, by a power of whose operations he is unconscious.[2]

In learning anything, particularly if it be of a difficult or complicated nature, it is necessary to reduce it to its elements, and bring the mind to master them one by one. Thus, in teaching a child to read or write, we begin by making it acquainted with the individual letters. These are afterwards combined into words, which again go to form sentences by which ideas are conveyed to the mind. In reading with the mind directed to the meaning, we are no longer distinctly conscious of the words and letters by means of which

[1] "We must, I think, admit that the thought of an object . . . is always accompanied by an escort more or less numerous of accessory thoughts equally present to the mind though in general unknown in themselves to consciousness ; that these accessories are not without their influence in guiding the operations elicited by the principal notion, and it may even be added that they are so much the more calculated to exert an effect in the conduct of our procedure in proportion as . . . the influences they exert are farther withdrawn in ordinary from the ken of consciousness."—*Sir W. Hamilton.*

[2] "From what cause does it happen that a good speaker no sooner conceives what he would express, than the letters, syllables, and words arrange themselves according to innumerable rules of speech while he never thinks of these rules? He means to express certain sentiments; in order to do this properly, a selection must be made of the materials out of many thousands. He makes this selection without any expense of time or thought. The materials selected must be arranged in a particular order according to innumerable rules of grammar, logic, and rhetoric, and accompanied with a particular tone and emphasis. He does all this as it were by inspiration, without thinking of any of these rules, and without breaking one of them."—*Dr. Thomas Reid.*

it is conveyed, but that these have all been before the mind can scarcely be doubted.[1] Our recognition of a word is not merely the recognition of the word as a whole, but it is the recognition of the individual letters of it, so that in reading, if a letter of a word is misplaced, we at once detect it. Hence it is that we may be able to recall certain letters of a word or a name without being able to remember the whole. We can, perhaps, say that it begins with a certain letter or ends with a certain other letter, and yet for a time may be unable to recall it. In like manner, a hint from a single letter may serve to recall a word or even a whole sentence. In looking over a book for the occurrence of a particular word or name, we cast the eye over a page and can almost immediately tell whether it is to be found there or not. "Here," says Sir W. Hamilton, "the mind is hardly conscious of a single word but that of which it is in quest; but yet it is evident that each word and letter must have produced an obscure effect, and which effect the mind was ready to discriminate and strengthen so as to call it into consciousness whenever the effect was found to be that which the letters of the word could determine."

In thought, too, doubtless the elementary parts of which an idea or thought is composed are present to

[1] In learning to read, "each word, each letter was originally a separate object of consciousness. At length the knowledge of letters, and words, and lines being, as it were, fused into our habits, we no longer have any distinct consciousness of them as severally concurring in the result of which alone we are conscious. But each word and letter has its effect, an effect which can at any moment become an object of consciousness."—*Sir W. Hamilton.* "In reading the page of a book, it is clear to me, however rapidly you may read it, that every letter of that page passes in review through the mind. The mind first combines the letters upon the page into words, then the words into sentences, and from those sentences it extracts the meaning."—*G. P. Bidder.*

the mind though they may not come before consciousness.[1] An expert accountant can run his eye over a column of figures and give the total correctly, without having had a conscious appreciation of any of the figures.[2] According to Dugald Stewart, "the mind may think and will without attending to its thoughts or volitions so as to be able afterwards to recollect them. . . . A man may be conscious of a perception without being able afterwards to recollect it."[3] May not this account for the fact that "persons under the influence of chloroform have been known to hear themselves shriek during the performance of a surgical operation at the very moment when they had no feeling of pain whatever"?—*Dr. Laycock.* May they not have felt the pain for a moment but ceased to remember it?

In our first attempts to walk, to write, to play on an instrument, or to carry on any other operation, we are intensely conscious of every movement that we make. By degrees, as we acquire more ease and dexterity in their performance, we become less and less conscious of them, till we may come to perform them quite unconsciously. "When a beginner is learning his notes on

[1] "In ordinary thinking we are as little conscious of the particular steps—our interest being concentrated on the result—as we are of the particular stages of an action."—*G. H. Lewes.*

[2] "An expert accountant, for example, can sum up almost with a single glance of his eye a long column of figures. He can tell the sum with unerring certainty, while at the same time he is unable to recollect any one of the figures of which that sum is composed, and yet nobody doubts that each of these figures has passed through his mind or supposes that when the rapidity of the process becomes so great that he is unable to recollect the various steps of it, he obtains the result by a sort of inspiration."—*D. Stewart.*

[3] "A perception or an idea which passes through the mind without leaving any trace on the memory may yet serve to introduce other ideas connected with it by the laws of association."—*D. Stewart.*

the pianoforte, he has deliberately to call to mind each note; but when, by frequent practice, he has acquired complete skill in playing on that instrument there is no conscious memory, but his movements are automatic."—*Dr. H. Maudsley.* There are some who hold that when actions thus come to be performed unconsciously, the mind ceases to have any part in the direction of them.[1] "In the case of some operations which are very familiar to us, we find ourselves unable to attend to or to recollect the acts of the will by which they were preceded; and accordingly some philosophers of great eminence have called in question the existence of such volitions, and have represented our habitual actions as involuntary and mechanical. But surely the circumstance of our inability to recollect our volitions does not authorise us to dispute their possibility any more than our inability to attend to the process of the

[1] "When we perform a train of movements without any further aid of the will than to commence the series, there must be a fixed connection between each and the one that follows."—*Prof. Bain.* We however agree with those who regard these movements as being still under the control of the will as at first, through the presence in the mind of ideas of which we are unconscious, and that the associated movements are in consequence of association of the ideas. "Where a person performing a difficult piece of music converses freely at the same time on some subject wholly alien to his occupation, . . . the consciousness passes with inappreciable rapidity from one subject to the other, giving the effect of being simultaneous to what is in reality a succession of states."—*Sir H. Holland.* "We are not conscious of the separate sensations which guide speech and writing. . . . Are these processes mechanical? By no means. We know that they were laboriously learned by long tentative efforts, each of which was accompanied by distinct consciousness. . . . To suppose that they pass from the psychical to the physical by frequent repetition would lead to the monstrous conclusion that, when a naturalist has by laborious study become so familiarised with the specific marks of an animal or plant that he can recognise at a glance a particular species, or recognise by a single character the nature of the rest, the rapidity and certainty of this judgment proves it to be a mechanical, not a mental act."—*G. H. Lewes.*

mind in estimating the distance of an object from the eye authorises us to affirm that the perception is instantaneous."—*D. Stewart.*[1]

Did our actions not become more and more easy of execution, and gain in rapidity by repetition, were we still as conscious of them as at first, comparatively little could be accomplished in the course of a lifetime. If, in order to walk, we had ever to carefully consider each step we took, or, in order to write, had always to attend to the formation of each letter—were all our other operations performed as painfully and as consciously as

[1] "I cannot help thinking it more philosophical to suppose that those actions which are originally voluntary always continue so, although . . . we may not be able to recollect every different volition. Thus, in the case of a performer on the harpsichord, I apprehend that there is an act of the will preceding every motion of every finger, although he may not be able to recollect these volitions afterwards, and although he may, during the time of his performance, be employed in carrying on a separate train of thought. . . . The truth seems to be that, in consequence of the association of ideas, the different steps of the process present themselves successively to the thoughts without any recollection on our part, and with a degree of rapidity proportioned to the length of our experience, so as to save us entirely the trouble of hesitation and reflection, by giving us every moment a precise and steady notion of the effect to be produced."—*D. Stewart.* "The point never to be left out of sight is that actions which are known to be preceded and accompanied by sensations do not lose their special character of sentience . . . because they are not preceded and accompanied by that peculiar state which is specially called consciousness. When we see a man playing the piano, and at the same time talking of something far removed from the music, we say his fingers move unconsciously, but we do not conclude that he is a musical machine—muscular sensations and musical sensations regulate every movement of his fingers; and if he strikes a false note, or if one of the notes jangles, he is instantly aware of the fact. . . . That a particular group of sensations, such as musical tones, will set going a particular group of muscular movement without the intervention of any conscious effort is not more to be interpreted on purely mechanical principles, than that a particular phrase will cause a story-teller to repeat a particular anecdote, or an old soldier 'to fight his battles o'er again'."—*G. H. Lewes.*

at first—life could scarcely fail to be a burden. In like manner, did everything that exists in the mind exist there consciously; or did every time that an idea occurred to the mind all the other ideas that had at any time been associated with it come up along with it, and a selection have to be consciously made of the right one, inconvenience and loss of time could not fail to result. In some persons, from habit or lack of proper training, an idea in the mind immediately recalls a number of other ideas, having more or less, and sometimes very little, connection with it,—thus distracting the mind with a multitude of thoughts, making the selection of the best a conscious act, producing hesitation and indecision, and causing loss of time. The selection of the right thoughts should be an act of the unconscious mind, and take place unconsciously.

The more we cultivate and train any power or faculty, the more easily and rapidly does it perform its work,—the less is consciousness concerned in it, the more work does it accomplish, and the less does it suffer from fatigue.[1] Our mental progress, then, is in the direction of our becoming unconscious, or largely unconscious, of many of our activities. Consciousness has at first an important place in the training of our

[1] "There is a remarkable law of the system by which actions at first requiring much attention are after frequent repetition performed with a much less degree of it, or without the mind being conscious of any effort. This is exemplified in various processes of daily occurrence, as reading and writing, but most remarkably in music."—*Dr. Abercrombie.* "Careful practice alone is needed in order that previously strange, difficult, and complex movements should be capable of being performed with ease, and that after a time, during the process of learning, first the 'Conception' of the movements needed, and subsequently the desire which originally prompted to their execution, may alike vanish as conscious states by which they are necessarily preceded."—*Dr. Bastian.*

faculties and the building up of our knowledge. The more consciousness is concentrated upon any new operation, the more readily is it mastered; and the more it is concentrated upon any idea brought before the mind, the better is it impressed upon the memory. But as we acquire facility and skill in the operation, as the memory acquires strength we become less conscious of them.[1] "The interference of consciousness," says Dr. Maudsley, "is often an actual hindrance to the association of ideas, as it notably is to the performance of movements that have attained the complete ease of an automatic execution." "In proportion as volition has to be exercised in carrying them on, in that proportion are they imperfectly performed, and then only at the expense of much labour and fatigue."—*J. D. Morell.*

The great object of education, then, should be to transfer as much as possible of our actions from the conscious to the unconscious region of the mind. "The possibility of all education," says Prof. Huxley, "is based upon the existence of this power, which the nervous system possesses of organising conscious actions into more or less unconscious or reflex operations." "A purely reflex action is accompanied with no fatigue at all, so that operations which were painful in the extreme to the muscles engaged so long as the will had to compel every movement for their performance, can after a while be kept up the whole day with scarcely any sense of weariness whatever."—*J. D. Morell.*

It is in the ultra-conscious region of the mind that

[1] "Consciousness does essential service in the building up of faculties of thought and action; its part is comparatively small in the use which we make of them afterwards. . . . There is not a faculty of the mind which, though they began by using it consciously, they do not after habitual practice exercise unconsciously."—*Dr. Maudsley.*

all its highest operations are carried on. It is here that genius works. "Shakespeare's intellect," says Carlyle, "is what I call an unconscious intellect; there is more virtue in it than he himself is aware of. . . . The latest generations of men will find new meanings in Shakespeare, new elucidations of their own human being." "I prefer," says Goethe, "that the principle from which, and through which, I work should be hidden from me." "Zerah Colburn, the American calculating boy, on being interrogated as to the way in which he obtained the results, constantly declared that he did not know how the answers came into his head."—*Dr. Carpenter.* "The sublimest works of intelligence are quite possible, and may be easily conceived to be executed, without any consciousness of them on the part of the apparent and immediate agent."—*Prof. Ferrier.*

How many thoughts, how much knowledge, would come into our minds if we would only let them—if we would simply keep our minds open to receive them![1] Unfortunately, however, our minds are too much preoccupied, are ever going after other things, and we are unable to hear the still, small voice within. "Were man to be without consciousness," says Prof. Ferrier, "by reason of the very absence of consciousness, the

[1] "Trust the instinct to the end, though you can render no reason. . . . It shall ripen into truth, and you shall know why you believe." —*R. W. Emerson.*

"Delicate omens traced in air
To the lone bard true witness bare;
Birds with auguries on their wings
Chanted undeceiving things
Him to beckon, him to warn;
Well might then the poet scorn
To learn of scribe or courier
Hints writ in vaster character."

—*Ditto.*

flood-gates of his being would stand wider than before, and let in upon him stronger and deeper currents of inspiration." "It is by spontaneous and not by reflective thought that the mind attains its clearest and most penetrating visions of things. . . . Almost always there is involved in them the gathered wisdom of long, and varied, and ripened experience; very often there are analyses, more or less refined; generalisations of a narrower or wider scope; and not unfrequently ratiocinations passing so rapidly, that the processes are not only not analysed, they are not even observed."—*Dr. M'Cosh.*

The highest form of memory, as of all the mental powers, is the unconscious—when what we wish to recall comes to us spontaneously, without any conscious thought or search for it. Frequently when we wish to recall something that has previously been in the mind we are unable to do so by any conscious effort of the will; but we turn the attention to something else, and after a time the desired information comes up spontaneously when we are not consciously thinking of it. "There is the working of a mechanism beneath the consciousness which, when once set going, runs on of itself, and which is more likely to evolve the desiderated result when the conscious activity of the mind is exerted in a direction altogether different."—*Dr. Carpenter.*

CHAPTER VII.

ATTENTION.

"Memory is very much influenced by attention, or a full and distinct perception of the fact or object, with a view to its being remembered."—*Dr. Abercrombie.*

"It is a matter of common remark that the permanence of the impression, which anything leaves on the memory, is proportioned to the degree of attention which was originally given to it."—*D. Stewart.*

"The experiences most permanently impressed upon consciousness are those upon which the greatest amount of attention has been fixed."—*D. G. Thompson.*

Attention "is so essentially subservient" to memory, "that without some degree of it the ideas and perceptions which pass through the mind seem to leave no trace behind them".—*D. Stewart.*

"An act of attention, that is an act of concentration, seems thus necessary to every exertion of consciousness, as a certain contraction of the pupil is requisite to every exertion of vision. . . . Attention, then, is to consciousness what the contraction of the pupil is to sight, or to the eye of the mind what the microscope or telescope is to the bodily eye. . . . It constitutes the better half of all intellectual power."—*Sir W. Hamilton.*

"It is this, much more than any difference in the abstract power of reasoning, which constitutes the vast difference which exists between minds of different individuals."—*Sir B. Brodie.*

"The most important intellectual habit that I know of" is "the habit of attending exclusively to the matter in hand. . . . It is commonly said that genius cannot be infused by education, yet this power of concentrated attention, which belongs as a part of his gift to every great discoverer, is unquestionably capable of almost indefinite augmentation by resolute practice."—*W. A. Butler.*

"The force wherewith anything strikes the mind is generally in proportion to the degree of attention bestowed upon it. . . The great art of memory is attention. . . . Inattentive people have always bad memories."—*Dr. J. Beattie*

ATTENTION is necessary to memory. The remembrance of anything depends upon the clearness and vividness of the impression originally made by it upon the mind, and this on the degree of attention with which it was regarded.[1] It is generally held by

[1] "It is a law of mind that the intensity of the present consciousness determines the vivacity of the future memory; memory and consciousness are thus in the direct ratio of each other. . . . Vivid consciousness, long memory; faint consciousness, short memory; no consciousness, no memory."—*Sir W. Hamilton.*

philosophers that without some degree of attention no impression of any duration could be made on the mind or laid up in the memory.[1] Impressions may be made on the senses, thoughts may pass through the mind, but unless the attention is directed to them they will be unobserved.[2] The defects of memory, of which most persons complain, are owing more to want of attention than to any other cause.[3] We remember what we attend to, but what we do not attend to we readily forget.

Attention is the fixing of the mind intently upon one particular object, to the exclusion for the time of all

[1] "Every phenomenon of consciousness proper must possess in some degree the attributes of clearness and distinctness without which it can leave no trace in the memory, and cannot be compared with other phenomena of the same class; and in order to this it is necessary that the phenomenon in question should have been observed with some degree of attention."—*Dean Mansel.* "I am inclined to suppose that it is essential to memory that the perception, or the idea which we would wish to remember, should remain in the mind for a certain space of time, and should be contemplated by it exclusively of everything else."—*D. Stewart.*

[2] "It is clearly not sufficient that an impression should be transmitted to the brain for it to be remembered. An act of the mind itself is necessary for that purpose, and that . . . is attention."—*Sir B. Brodie.* "Place yourself in the crowded streets of a city, a thousand objects of vision before your eye, sounds hardly less various coming upon the ear, odours also constantly changing, contact or collision at any moment with some external object. Amidst this multitude of physical objects, and with all the organs of sense seemingly open, one alone will be found at each moment distinctly present to the mind. . . . Or let the mind pass suddenly by will or accident into a train of inward thought . . . and all the external objects thus crowded around you utterly disappear, though the physical agents producing, and the organs receiving, sensations remain precisely as before."—*Sir H. Holland.*

[3] "It is only a small proportion of what we see, or hear, or feel, or imagine, that is not immediately forgotten, simply because there are very few of these things to which we pay more than a momentary attention."—*Sir B. Brodie.* "The habit of hasty and inexact observation . . . is necessarily the foundation of a habit of remembering wrongly; and the habit of remembering wrongly is of necessity the cause of an incorrect judgment and erroneous imagination."—*Dr. H. Maudsley.*

other objects that solicit its notice. It is not, strictly speaking, a special faculty of the mind, but is a mode of activity equally applicable to all its states. It is a particular form of consciousness, and acts altogether irrespective of the object to which it is applied, being equally suitable to every occasion for which it is required. Sir W. Hamilton defines it as "consciousness voluntarily applied under its law of limitations to some determinate object". This law of limitations, he says, is "that the intention of our knowledge is in the inverse ratio of its extension,"—in other words, "that the greater the number of objects to which our consciousness is simultaneously extended, the smaller is the intensity with which it is able to consider each, and consequently the less vivid and distinct will be the information it obtains of the several objects. . . . When our interest in any particular object is excited, and when we wish to obtain all the knowledge concerning it in our power, it behoves us to limit our consideration to that object to the exclusion of others."

The human mind is single, and can only be in one state or engaged in one kind of activity at the same instant of time.[1] It can, however, pass with amazing rapidity from one state or from one form of activity to

[1] "Whether we have the power of attending to more than one thing at one and the same instant?" The negative opinion "appears to me to be the most reasonable and philosophical that we can form on the subject".—*D. Stewart.* "A plurality of stimulations of the nerves may coexist, but they can affect the consciousness only by turns, or one at a time."—*Prof. Bain.* "It is established by experience that we cannot give our attention to two different objects at the same time."—*M. Jouffroy.* "Two thoughts or acts of memory, however closely related to one another, cannot be presumed to exist at the same instant,—each has its individuality in time."—*Sir H. Holland.* "The nature of our organism prevents our having more than one aspect of an object at each instant presented to consciousness."—*G. H. Lewis.*

another, so as to give the impression that it may be in several states or carry on several operations at once, but this is simply owing to the rapidity with which it can pass from one to another.[1] Hence, when taken up with one object others may present themselves to it and be unobserved. Thus, the clock may strike in the room beside us, and, if the mind is otherwise engaged, we may fail to perceive it.[2] In like manner wounds received in the heat of battle may be unfelt for a time, owing to the mind being otherwise occupied.[3]

When, on the other hand, the attention is unengaged or free, the lightest impressions will be perceived;[4] and it has the power of intensifying or magnifying any impression or thought to which it may be directed.[5] Thus impressions, feeble or insignificant in themselves,

[1] "The best philosophers are agreed that the mind cannot actually attend to more than one thing at a time, but, when it so appears, is in reality shifting with prodigious rapidity backwards and forwards from one to the other."—*Archbp. Whately.* It is "impossible that the mind should be engaged in two topics at the same instant. The expertness which seems to accomplish this feat is, in fact, a highly developed power of glancing from one subject to another with great rapidity—a sort of mental trapeze-flying, wherein the performer often gets an ugly fall, and may be permanently disabled."—*Dr. M. Granville.* "The fact never to be forgotten is that the human mind can attend to only one thing at a time, although it may shift the attention very rapidly, and thus overtake two or more things by turns."—*Prof. Bain.*

[2] "He whose mind is intensely employed in any particular pursuit, may have his eyes open upon an object which he sees not, or he may not hear the sound of a clock striking within two yards of him."—*Dr. G. Payne.*

[3] "It is well known that impressions fail to produce consciousness when the mind is strongly pre-engaged. In the heat of a battle wounds may be for a time unfelt."—*Prof. Bain.*

[4] "Those things are . . . best remembered which occur when the mind is at ease and unemployed."—*Dr. J. Beattie.*

[5] "Whatever be its relations to the special faculties, attention doubles all their efficiency and affords them a power of which they would otherwise be destitute."—*Sir W. Hamilton.*

may be raised to even a painful degree of acuteness by having the attention strongly directed to them, and may thus occasion much suffering.[1] By concentrating the attention upon an object, we not only perceive it more clearly, but we call forth the ideas that have at different times been associated with it; and at the same time all that we hear or read concerning it makes a deeper impression.[2] Hence, if we form in the mind a general idea of the contents of a book before reading it, we grasp at different parts much more readily, and fix them in the memory much better than we could otherwise do.[3] It is by means of attention that one is able to listen to one or other of several persons speaking at the same time, or to one voice or instrument in a concert to the neglect of others.[4]

[1] "A painful sensation becomes more intolerable the more the attention is directed to it. A sensation, in itself inconsiderable, as an itching in a very small spot of the skin, is thus rendered very troublesome and enduring."—*Dr. J. Müller.* "If the attention be steadily directed to almost any part of the surface of the body, some feeling of itching, creeping, or tickling will soon be experienced."—*Dr. Carpenter.*

[2] "By attending to an object we give it the opportunity of exciting all the ideas with which it is associated."—*Jas. Mill.* "When the attention is strongly fixed on any particular subject, all that is said concerning it makes a deeper impression upon the mind."—*Isaac Watts.*

[3] "After a rapid glance on the subject and distribution of a new book, I suspend the reading of it, which I only resume after having myself examined the subject in all its relations."—*E. Gibbon.*

[4] "Although many images may be simultaneously existing upon the retina, the mind possesses the power of singling out any one of them and fastening attention upon it, just as among a number of musical instruments simultaneously played, one, and that perhaps the feeblest, may be selected and its notes exclusively followed."—*Dr. Draper.* "In a concert of several voices, the voices being of nearly equal intensity, regarded merely as organic impressions on the auditory nerve, we select one, and at will we lift it out and disjoin it from the general volume of sound; we shut off the other voices—five, ten, or more—and follow this one alone. When we have done

The greater one's power of attention, the longer and more steadily he is able to fix it upon a subject, the better will he be able to follow out the same train of thought, and the greater will be the amount of success attending his labours.[1] It is this power of attention,—this power of keeping a particular object before the mind till he has thoroughly mastered it, that more than anything else distinguishes the man of genius from others. Indeed, it is said that "possibly the most comprehensive definition of genius is the power of concentrating and prolonging the attention upon any one given subject". Sir Isaac Newton, in describing his method of study, said: "I keep the subject continually before me, and wait till the first dawning opens slowly by little and little into a clear light"; and, when complimented on his great discoveries, he modestly replied, "that if he had made any improvements in the sciences, it was owing more to patient attention than to any other talent". "For rising to eminence in any intellectual pursuit," says Dr. Abercrombie, "there is not a rule of more essential importance than that of doing one thing at a time,—avoiding all distracting and desultory occupations,—and keeping a leading object continually before the mind." "The mind that possesses this faculty in the greatest degree of perfection will take cognisance of relations of which another mind has no perception."—*Sir B. Brodie.*

On the other hand there is no more marked charac-

so for a time, we freely cast it off and take up another."—*Isaac Taylor.*

[1] "The more completely the mental energy can be brought into one focus, and all distracting objects excluded, the more powerful will be the volitional effort."—*Dr. Carpenter.* "The power and habit of thinking closely and continuously upon the subject in hand, to the exclusion for the time of all other subjects, is one of the principal,—if not the principal,—means of success."—*Sir J. Y. Simpson.*

teristic of a weak mind than that of want of power to concentrate the attention upon an object for any length of time.[1] "Imbeciles and idiots," says Esquirol, "are destitute of the faculty of attention;"[2] and medical men say that "one of the most constant and characteristic symptoms of coming insanity is a debilitated power of attention. . . . The growing deficiency of attention points to a coming imbecility, and especially to an impending attack of softening of the brain."[3]

It is commonly said that in the decay of our powers through age the memory is the first faculty that fails; but this is not strictly correct, for it is the power of attention, on which the memory depends, that is the first to deteriorate. Hence, it is the most recent subjects,—the things of yesterday or last week,—those that have not been sufficiently attended to, that are the first to disappear. The things of years ago and of early life, those that have been attended to and are established, are the last to be forgotten.[4]

[1] "The mind which is deficient in concentrative power is lamentably deranged by any kind of emotional excitement in the performance of any volitional effort."—*Dr. Carpenter.*

[2] "They see badly, hear badly, feel badly, and their sensorium is, in consequence, in a similar condition of sensitive poverty. Its impressionability for the things of the external world is at a minimum, its sensibility weak, and consequently it is difficult to provoke the condition of physiological erethism necessary for the absorption of the external impression."—*J. Luys.*

[3] "In all forms of mental disease the faculty of attention becomes gradually weaker, and presents, according to the intensity of the morbid process, different and fatally progressive modifications."—*J. Luys.*

[4] In the natural decay of memory it is observed that "recent events are retained with difficulty and soon forgotten; while those of older date are easily and accurately recalled. This has been referred, and rightly I believe, to the differing degree of interest, and therefore of attention, which the same objects excite in the young and in the old. It would seem as if the effort of attention stamped characters upon the material fabric which are deep and lasting in the

Seeing, then, the importance of attention, it is of the utmost consequence, not only for memory but for all our faculties, that we strive to improve and strengthen it by every means in our power.[1] In order to this it is necessary to acquire the habit of thinking of, or doing, only one thing at a time.[2] There is nothing contributes more to success in any pursuit than that of having the attention concentrated on the matter in hand; and, on the contrary, nothing is more detrimental than when doing one thing to have the mind taken up with something else.[3] We read of one that "she did things easily, because she attended to them in the doing. When she made bread she thought of the bread, and not of the fashion of her next dress, or of her partner at the last dance."[4] One, when asked how he found time to do so much, said that it was by always concencentrating his attention upon that which was before him. "There is time enough for everything in the course of the day," says Lord Chesterfield, "if you do but one thing at once; but there is not time enough in

youthful brain, faint in advanced life, and often altogether effaced in old age."—*Sir Thos. Watson.*

[1] "It would form a most valuable article in a systematical treatise on education to point out the means by which this habit of attention may be cultivated, or the contrary habits of inattention corrected where they have unfortunately been contracted."—*D. Stewart.*

[2] "It is a matter of no small importance that we acquire the habit of doing only one thing at a time; by which I mean that while employed on any one object, our thoughts ought not to wander to another."—*Dr. J. Beattie.*

[3] "A frequent cause of failure in the faculty of attention is striving to think of more than one thing at a time."—*Dr. M. Granville.*

[4] "When we go from home, or to the fields for exercise, we should leave all our speculations behind, otherwise we will fatigue the body and distract the mind, and will confirm ourselves in those habits of inattention which, when persisted in, form what is called an absent person."—*Dr. J. Beattie.*

the year if you will do two things at a time." Many a clever man has made shipwreck of his life by striving to do two things at once. It is by doing one thing at a time that we come in time to do many things. "The shortest way," says Lord Burleigh, "to do many things is to do one thing at a time." It is as one is able to shut out every other object, every other idea, even self, from the mind that he attains the highest degree of mental power.[1] The actor or the orator, who can so throw himself into his character or subject as to be oblivious of everything but that, is the one that is most natural and therefore moves the audience more powerfully.[2] Mrs. Siddons, we are told, was wont to so throw herself into the character of the person she was representing as to quite lose sight of her own personality, and to think and act in the character of her heroine.[3]

It may seem to militate against this view that sometimes the mind appears to attend best to a thing when

[1] Archbishop Whately cured a person of shyness by saying: "You are shy because you are thinking of the impression you are making. Think only of the pleasure you can give to others, and not of yourself." In speaking of bashfulness he says: "Let both the extemporary speaker and the reader of his own compositions study to avoid as far as possible all thoughts of self, earnestly fixing the mind on the matter of what is delivered; and the one will feel the less of that embarrassment which arises from the thought of what opinion the hearers will form of him, while the other will appear to be speaking, because he actually will be speaking, the sentiments, not indeed which at that time first arise in his own mind, but which are then really present to, and occupy, his mind".

[2] "If a public speaker or tragedian thinks of the action which he is about to use while he is striving to feel what he is uttering, he is as likely as not to give the right action in the wrong place, or the wrong action in the right place, or to give the wrong action in the wrong place."—*C. W. Smith.*

[3] "Some of our greatest actors—especially of the female sex—become so completely engrossed in the 'parts' they play as to lose altogether for the time the sense of their own personality, and to be rather than act the characters they have assumed."—*Dr. Carpenter.*

it has something else, which does not greatly call forth the attention, to occupy it at the same time. Thus some persons think best on a subject when their hands are taken up with something, or when listening to a piece of music or a dull sermon.[1] We do not obtain the highest form of attention in this way, and it is a bad habit requiring to be corrected; but sometimes it is well to take advantage of it. We account for it thus: when the attention is feeble or exhausted, when it cannot retain hold of a thing for any length of time, but is constantly wandering off to others, then it is well that something be found for it that will not make great demands upon it, on which it may fall back from time to time, and from which it may return refreshed to the principal subject.

If we would possess the power of attention in a high degree, we must cultivate the habit of attending to what is directly before the mind, to the exclusion of all else. All distracting thoughts and feelings that tend to withdraw the mind from what is immediately before it are therefore to be carefully avoided.[2] This is a matter of great importance, and of no little difficulty. Frequently the mind, in place of being concentrated on what is immediately before it, is thinking of something else—something, it may be, that went before or that

[1] "It is a fact, and a very curious one, that many people find they can best attend to any serious matter when they are occupied with something else which requires a little, and but a little, attention; such as working with the needle, cutting open paper leaves, or, for want of some such employment, fiddling anyhow with the fingers." —*Archbp. Whately.*

[2] "It is necessary, then, that one single impression at a time shall be imprinted upon the sensorium, and that moreover the elements of the sensorium shall themselves be in a kind of silence and relative calm."—*J. Luys.* "There are two great causes of distraction or inattention—external impressions and internal emotions."—*W. Stokes.*

may come after, or something quite alien to the subject.[1] Sometimes the very anxiety to remember a thing causes the forgetting of it; the mind, in place of simply receiving the impressions as they are presented to it, harassing itself with such questions as—"Shall I remember this?" "Have I forgotten that?" "What was said just now?"[2] Sometimes the mind may be taken up with the meaning of a word or sentence, to the neglect of the letters or words or sounds that go to make it up, and which it is desired to impress upon the mind.[3] Hence, in training the mind to remember words or sounds, it is sometimes desirable that the words be such as convey, or be used in such a way as

[1] "While listening to a sermon or lecture, or whilst reading . . . our thoughts are apt to revert to the ideas which preceded, instead of being concentrated upon the required point. In public speaking this . . . is still more distracting, as not only that which has been said, but that which is about to be said, thrusts itself forward and effectually interferes with that which is being said, and which ought to receive undivided attention."—*W. Stokes.* "A diffident but quick reader or speaker not uncommonly worries himself about the pronunciation of a word some distance in advance of him, and even rehearses it mentally."—*Dr. M. Granville.*

[2] "The mind, instead of being occupied in grasping that which is wanted, may be soliloquising thus—'Dear me, I fear I shall not remember all this; I wonder whether I have forgotten what was said just now! What was it? Let me see!'"—*W. Stokes.*

[3] "In a large class of minds the faculty of apprehension is developed, as it were, at the cost of that of mental registering or memory; the force of the intellect being expended in understanding, while the storing of impressions is left to chance, which generally means that it is neglected. . . . A man may concentrate his attention and bring his reasoning faculties to bear on a subject of study, mastering its details and obtaining a clear comprehension of the whole, while he is not registering any impression to form the basis of a memory."—*Dr. M. Granville.* "The effect of etymological knowledge concerning the origin and the changes in meaning of a perfectly intelligible word, where such knowledge is awakened in our minds at the sight or on the utterance of the word, . . . is undoubtedly to divide the attention between the present and the past significations, whence in the rapidity of discourse vacillation and confusion are naturally apt to arise."—*S. Bailey.*

to convey, no meaning by which the attention may be distracted.[1]

De Quincey gives a very striking instance of the way in which the understanding sometimes steps in and perverts impressions received by sense, in the case of a man ignorant of perspective attempting to draw an object depending on the laws of that science. "He will be utterly unable," he says, "to make the smallest approximation to it. Yet why? For he has actually seen the effect every day in his life. The reason is that he allows his understanding to overrule his eyes . . . for not only does the man believe the evidence of his understanding in opposition to that of his eyes, but the idiot is not aware that his eyes ever gave him such evidence. He does not know that he has seen that which he has seen every day of his life."

Further, almost every object presented to the mind is compound, made up of several parts, so that if we would obtain a clear and accurate impression of the whole or of any of its parts, it is necessary to bring each part individually before the mind by itself. Thus an apple presents to us form, colour, taste, smell, &c.; and if we would obtain a clear idea of any one of these, we must contemplate it by itself and compare it with other impressions of the same kind that we have previously experienced. So in viewing a landscape, it is not enough to regard it merely as a whole, but we must regard each of its different parts individually by itself if we would have a clear idea of it. We can only obtain a full and complete knowledge of an object by analysing

[1] "Unconnected words form the very best material for inflective exercise."—*A. M. Bell.* "The language memory . . . carries a great many things in the unmeaning state; and the more we are endowed with it the farther we can go in dispensing with the full comprehension of what we are laying up."—*Prof. Bain.*

it and concentrating the attention upon its different parts one by one. "It is not," says Dr. T. Reid, "by the senses immediately, but rather by the power of analysing and abstraction, that we get the most simple and the most distinct notions even of objects of sense." Still more is this true with regard to our intellectual ideas. "It is scarcely possible," says Dr. T. Brown, "to advance even a single step in intellectual physics without the necessity of performing some sort of analysis."

In the acquisition of any particular set of movements we do so best and most readily by analysing them, and bringing the attention to bear upon them one by one.[1] In the simple process of walking we have three distinct movements. "The heel of the foot extended first touches the ground, then the sole just as the heel of the other foot begins to leave the ground, and last of all the pupil rises upon the ball of his toes." These three movements performed in turn by both feet constitute walking, and by directing attention to each of these movements in turn one will soon learn to walk easily and well.[2] It is not the length of time that one may be engaged in any exercise, nor the frequency with

[1] "In our mechanical education complex and difficult actions are acquired by taking the simple acts separately. We learn part No. 1 by itself; then part No. 2, No. 3, and so on; and if each of these parts be so firmly acquired as to be maintained without any exercise of the attention, there will be no new labour in performing them together."—*Prof. Bain.* "Man can readily acquire surprising kinds of dexterity if he confines his attention to their acquisition. Specialisation is the mother of proficiency."—*Dr. E. Hering.*

[2] In training recruits to use the rifle they are first made to take sights with the musket laid on a rest. They are afterwards taught, one by one, the different movements connected with firing, close attention being paid to each; and they practise blank firing for some time, so as to get accustomed to the report and recoil before using ball.

which he may practise it, but it is the amount of attention that is bestowed upon it that constitutes its advantage.[1] In this, as in other things, "a month of training is worth years of practice".

In teaching any subject, then, we should seek to reduce it to its simplest parts, and bring the mind to concentrate its energies upon them one by one.[2] The more minute and simple the object to which the attention is directed, the clearer and more vivid will be the impression formed of it in the mind.[3] It is in learning as in war: the more we divide our foes the more easily do we conquer them. In this way much time and labour will be saved to the pupil, and greater accuracy secured. The more complicated and difficult the subject, the greater will be the advantages to be derived from this mode of procedure. (See Chapter IX.)

It is on this principle that the advantages arising from "division of labour" depend. As is well known, the same number of men will produce a much greater amount of work in a given time by each one confining his attention to a certain part of the process than by

[1] Horatio Ross, a great authority on shooting, says that 20 shots a day fired carefully and the results noted are better than 100, from the fact that one could not bestow the same care and attention on the 100 as on the 20.

[2] "In matters of education . . . where different subjects have to be mastered, or where numerous details have to be impressed on the memory, concentration on one exercise for a certain time is indispensable; and in those subjects that proceed on a double line the attention should be sustained in one of the two directions, instead of flitting between both."—*Prof. Bain.* "One of the chief results" of education "is that it exercises us in the habit of thinking of one thing at a time, of thinking therefore without confusion, and of arriving at conclusions with precision and decision".—*Dr. Draper.*

[3] "In learning any new thing there should be as little as possible first proposed to the mind at once, and that being understood and fully mastered, proceed then to the next adjoining part then unknown."—*Isaac Watts.*

each carrying out the whole. Pin making and steel-pen making are well-known instances of this (p. 83). The reason is that, the attention being thus confined to only a small part of the process, the muscles employed acquire increased dexterity, and can continue longer in action without suffering from fatigue. In addition to this, there is always a considerable amount of time wasted in passing from one form of activity to another. When the attention has been for some time engaged upon a particular occupation, it cannot at once with full effect pass to a different one.[1] It can, however, pass more readily from one form of activity to another of the same kind than from one to another of different kinds. Thus it passes more readily from one object of sight to another, or from one sound to another, than from a sight to a sound or a sound to a sight. After a flash of light we more readily apprehend another flash than a sound or any other sensation. It has been proved by experiment that if we are led to expect a particular kind of sensation, the mind apprehends it more readily than if left in doubt as to what the kind of sensation is to be.[2] This will be readily understood

[1] "When the human hand or human head has been for some time occupied in any kind of work it cannot instantly change its employment with full effect. . . . A similar result seems to take place in any change of mental exertion; the attention bestowed on the new subject not being so perfect at first as it becomes after some exercise." —*C. Babbage.*

[2] This is proved among others by the experiments of MM. Donders and De Jaager:—"One of them pronounced a syllable; the other repeated it as soon as he heard it. . . . When the repeated syllable had been agreed on beforehand the difference observed was two-tenths of a second; in the other case it was three-tenths. Analogous results were obtained by an observer noting the appearance of a white or red light, and being in turn informed and not informed which would be shown. . . . M. de Jaager told the person on whom he was experimenting to touch the key of the electric machine with his left hand when he received the shock on his right side, and

when we consider that the human mind is single, and can only be in one place or engaged in one form of activity at the same instant of time, and that each of the different faculties has its distinct seat.

The principle of "division of labour" holds equally true in intellectual as in manual or bodily occupations. Thus, if one has occasion to write on any subject, he will do so most satisfactorily by first thinking out his subject thoroughly before attempting to clothe it in language; and when this is once done he will then be able to give all his attention to the selection of the best modes of expression. It is said of the late eloquent preacher, Dr. Chalmers, that "he never had the double task to do at once of thinking what he should say and how he should say it. The one was over before the other commenced. . . . When engaged, therefore, in writing his whole undivided attention was given to the best and most powerful expression of preconceived ideas."

With every act of attention there is a corresponding physical change in the parts of the body directly concerned in it.[1] In particular it produces a certain amount

with his right hand when he received the shock on his left side. . . . Sometimes the person was told beforehand that the shock would be received on a particular side, the right for instance; in this case the interval between the shock he received and the consecutive signal he gave amounted to ·2 of a second. Sometimes he was not told on what side he would receive the shock . . . in this case the interval between the shock he received and the consecutive signal he gave amounted to ·27 of a second."—*H. Taine.*

[1] "Physiologically, attention consists of two processes, each distinct, yet mutually dependent. First, the organs of special sense by which the vague impressions are received are put into such a vital condition that the influence of the impressions upon the recipient nerves is intensified. . . . This occurs when we try to smell, to taste, to hear, to feel by touch more distinctly. . . . Secondly, the nerves by which the impressions are received, and the corresponding ganglia to which they are conveyed, are at the same time so modified

of waste which calls for an additional supply of blood to compensate for the loss thereby sustained.[1] Hence whatever interferes with a due supply of blood to the parts—as physical weakness or exhaustion, or the mind being taken up with something else—impairs the act of attention.[2] In this way we can understand how it is that if the attention be strongly directed to any part or organ of the body congestion and disease may be produced in it.[3] A person imagining that he is suffering from disease of the heart, and frequently directing his attention to the movements of that organ, may produce disease there where originally there was none; and, in

in function that they also become more susceptible of the influence of the impressions thus more determinately received in consequence of the volitional act."—*Dr. Laycock.*

[1] It is at the expense of its substance that it (the cerebral cell) produces movement, vibrates, enters into erethism, and becomes attentive."—*J. Luys.*

[2] "A certain expenditure of nervous power is involved in every . . . act of impressing the memory . . . and the more the better. This supposes, however, that we should withdraw the forces for a time from every other competing exercise, and especially that we should redeem all wasting expenditure for the purpose in view."—*Prof. Bain.*

[3] "The continuous direction of the attention to vital tissues imagined to be in an unhealthy state undoubtedly causes an exaltation of their special functions and an increase of sensibility, by (it may be presumed) diverging to them an abnormal quantity of blood, this being followed consecutively by—(1) undue vascular action, (2) capillary congestion, (3) an excess in the evolution of nerve force, and (4) appreciable structural alterations."—*Dr. Forbes Winslow.* "When the attention is directed to any portion of the body, innervation and circulation are excited locally, and the functional activity of that portion developed. This is well shown in the common forms of hypochondriasis, in which the patient being morbidly anxious as to the state of some particular organ—*e.g.*, the heart—constantly directs his attention to it, and thus functional disorder, and even structural disease, are caused."—*Dr. Laycock.* "There can be no doubt that real disease often supervenes upon fancied ailment, especially through the indulgence of what is known as the hypochondriacal tendency to dwell upon uneasy sensations; these sensations being themselves in many instances purely subjective."—*Dr. Carpenter.*

like manner, we are told that "the idea that a structural defect will certainly be removed by a certain act increases the organic action of the part, and sometimes produces a cure".—*Dr. J. Müller.*

The effect on the body of concentrating the attention on any particular operation is to confine its activity to certain channels and to withdraw it from others.[1] It is, as we have said, characteristic of all untrained activity that it is diffuse, more parts being brought into action than are necessary to effect the required result.[2] The effect of training and attention is more and more to confine the activity to special channels, so that the actions themselves are better performed, and can be kept up longer without producing fatigue. All progress in animal bodies proceeds by differentiation. Certain organs at first perform a number of different functions, but by degrees they differentiate, parts of them appropriating to themselves certain of the functions, and

[1] "Now the only view that we can take of the physical machinery of those actions is to suppose that the originally diffused wave that accompanied them has become contracted within some narrow circles of the brain which just suffice for the bare performance of the operations implied in them."—*Prof. Bain.*

[2] "An awkward person in performing one voluntary movement makes many others, which are produced involuntarily by consensual nervous action. It is only by education that we acquire the power of confining the influence of volition in the production of voluntary motions to a certain number of nervous fibres issuing from the brain."—*Dr. J. Müller.* "In our first attempts to write, to cipher, to play on an instrument, to speak, or in any other work of mechanical skill, the inward sense of labour and difficulty is corresponded to by the number of awkward and irrelevant gesticulations. On the other hand, in the last stage of consummated facility and routine the consciousness is almost nothing; and the general quietude of the body demonstrates that the course of power has now become narrowed to the one channel necessary for the exact movements required. . . . The tendency of all nervous states" is "by repetition to narrow their compass of action and to run into special channels of connection with the states that happen to succeed them, substituting intellectual trains for emotional outbursts".—*Prof. Bain.*

other parts other functions. Thus the spheres of their activities become narrowed, fewer cells and fibres are called into play in the performance of any particular operation, which comes thereby to be more efficiently performed in consequence of the attention being more concentrated upon it.

The effect of attention upon our physical organs is very remarkable. We all know the difference between a thing happening to us unexpectedly—as the foot slipping by accident—and when we are on the outlook for it. "We have all experienced," says Sir Charles Bell, "the difference between a blow unexpectedly received and one received when on our guard. Even on the same part of the body the effect will be very different. Boxers receive the hardest blows without injury. In consequence of the state of preparation in which they hold themselves when about to receive a blow, and the habit of sudden and powerful exertion of the muscles, the opponent's fist is repelled as from a board. . . . Thus we can explain the feat sometimes performed of breaking a poker over the arm, by which without a strong action and preparation of the muscles the arm bone would probably be fractured and the flesh bruised." In feats of dexterity and skill, in like manner, everything depends upon having the attention fully concentrated upon the parts immediately concerned. It would seem as if the mind itself in the act of attention passed into these parts, and was the moving, guiding, and sustaining spirit therein, or, in the words of Prof. Cleland already quoted, that it "works in connection with as much of the nervous system as is at any one time united to the brain by nerve channels in an active state". This seems at least as probable as the received opinion that the mind has its seat only in the distant

brain, from which it goeth not out, but directeth therefrom all the movements of the body (p. 149 *et seq.*).

The attention, like any other power or faculty of the mind, comes through practice to act in a great measure unconsciously. When thinking on a subject it will no longer be necessary as at first to exclude every other subject from the mind, for the mind will do this of itself; nor, when it is necessary to analyse a subject and to concentrate the attention upon its different parts separately, will any great conscious effort be involved, for it will be done so naturally and expeditiously that the mind will be but little, if at all, conscious of it.

CHAPTER VIII.

ASSOCIATION OF IDEAS.

"Next to the effect of attention is the remarkable influence produced upon memory by association."—*Dr. Abercrombie.*

"The recording power (of memory) mainly depends upon the degree of attention we give . . . to the idea to be remembered. . . . The reproducing power again altogether depends upon the nature of the associations by which the new idea has been linked on to other ideas which have been previously recorded."—*Dr. Carpenter.*

"The connection between memory and the association of ideas is so striking that it has been supposed by some that the whole of its phenomena might be resolved into this principle. . . . The association of ideas connects our various thoughts with each other, so as to present them to the mind in a certain order; but it presupposes the existence of these thoughts in the mind,—or, in other words, it presupposes a faculty of retaining the knowledge which we acquire. . . . On the other hand it is evident that without the associating principle the power of retaining our thoughts, and of recognising them when they occur to us, would have been of little use; for the most important articles of our knowledge might have remained latent in the mind, even when those occasions presented themselves to which they were immediately applicable."—*Dugald Stewart.*

"The most fundamental law which regulates psychological phenomena is the law of association. In its comprehensive character it is comparable to the law of attraction in the physical world."—*Th. Ribot.*

"That which the law of gravitation is to astronomy, that which the elementary properties of the tissues are to physiology, the law of the association of ideas is to psychology."—*J. S. Mill.*

"The habit of correct association . . . is one of the principal means of improving the memory, particularly that kind of memory which is an essential quality of a cultivated mind—namely, that which is founded not upon incidental connections but on true and important relations."—*Dr. Abercrombie.*

"Every case of forgetfulness is a case of weakened or extinct association."—*Jas. Mill.*

IN order to impress a thing upon the memory it is necessary, as we have seen, to regard it apart from other things, and to concentrate the attention upon it by itself. In order, however, that what is in the memory may be recalled or brought again before consciousness, it is necessary that it be regarded in connection, or in association, with one or more other things

or ideas,[1] and, as a rule, the greater the number of other things with which it is associated the greater the likelihood of its recall.[2] The two processes are involved in every act of memory. We must first impress, and then we must associate. Without a clear impression being formed, that which is recalled will be indistinct and inaccurate, and unless it is associated with something else in the mind it cannot be recalled. If we may suppose an idea existing in the mind by itself unconnected with any other idea, its recall would be impossible. In this way we account for those states of double consciousness, in which an individual appears to exist in two distinct states of mind,—having no recollection in the one state of what he thought or did in the other.[3] The transition from the one state to the

[1] "The principle of association is founded upon a remarkable tendency by which two or more facts, or conceptions which have been contemplated together, or in immediate succession, become so connected in the mind that one of them at a future time recalls the others."—*Dr. Abercrombie.*

[2] "Although the single relations established between ideas . . . may suffice for their mutual connection, yet that connection becomes much stronger when two or more such relations exist consentaneously."—*Dr. W. B. Carpenter.* "Associations that are individually too weak to operate the revival of a past idea may succeed by acting together."—*Prof. Bain.*

[3] What is called double consciousness "consists in an individual recollecting, during a paroxysm, circumstances which occurred in a former attack, though there was no remembrance of them during the interval".—*Dr. Abercrombie.* "If two groups (of ideas) are distinctly severed, so that no element of the one calls up any element of the other, we shall have . . . two moral personalities in the same individual."—*H. Taine.* "It is the peculiarity of somnambulism . . . that we have no recollection when we awake of what has occurred during its continuance. Consciousness is thus cut in two ; memory does not connect the train of consciousness in the one state with the train of consciousness in the other. When the patient again relapses into the state of somnambulism he again remembers all that had occurred during every former alternative of that state."—*Sir W Hamilton.*

other would appear to be so abrupt and complete that there is no link of association to connect them. We often fail to recall a past idea through the links of association being too feeble to bring it up before the mind.[1]

When once an idea is clearly impressed upon the mind, we can readily associate it with other ideas however dissimilar, but to seek to associate it with others before it is clearly impressed, or to attempt to carry out the two processes at once, is contrary to the principles on which the mind acts, as explained in the last chapter.

The two leading principles or laws on which associations are formed are contiguity and similarity.[2] Every sensation or thought that enters the mind is connected with the sensation or thought that immediately preceded it, and is in like manner connected with that which directly follows it. This is association by contiguity. Besides this a present sensation or thought in the mind may recall previous sensations or thoughts of a like kind, and become associated with them. This is association by similarity.

The great law of mental association is that of contiguity, by means of which sensations or ideas that have been in the mind together or in close succession, tend to unite together, or cohere in such a way that the

[1] "Numerous links of association are so feeble that they are speedily snapped like threads, and when the mind tries to return to them it finds the line of continuity broken and the recovery of the lost ideas hopeless."—*Anon.* "There are things of which I have entirely lost the recollection, . . . the associations which were formed between the ideas of them are so completely dissolved that none of my present ideas has the power of exciting them."—*Jas. Mill.*

[2] "The two principal facts which serve as the basis of association are resemblance and contiguity."—*Th. Ribot.*

one can afterwards recall the other.[1] The connection that naturally subsists between a sensation or idea in the mind, and that which immediately preceded or followed it, is of the strongest and most intimate nature. The two, strictly speaking, are but one, forming one complete thought. "To speak correctly," says H. Taine, "there is no isolated or separate sensation. A sensation is a state which begins as a continuation of preceding ones, and ends by losing itself in those following it; it is by an arbitrary severing, and for the convenience of language, that we set it apart as we do; its beginning is the end of another, and its ending the beginning of another."[2] "When we read or hear a sentence for example," says Th. Ribot, "at the commencement of the fifth word, something of the fourth word still remains. Each state of consciousness is only progressively effaced; it leaves an evanescent trace, similar to that which, in the physiology of sight, is called an after-sensation. Hence the fourth and fifth words are in contiguity, and the end of the one impinges upon the beginning of the other. That is the important fact. There is not an indeterminate contiguity of two somethings, but the initial point of one actual state touches the final point of the anterior state."

Contiguity is of two kinds—successive and synchro-

[1] "The connection which is formed in the mind between the words of a language and the ideas they denote; the connection which is formed between the different words of a discourse we have committed to memory; the connection between the different notes of a piece of music in the mind of the musician, are all obvious instances of the general law of our nature."—*Sir W. Hamilton.*

[2] "The impression A (having previously been many times followed by B) must lean in its vibration towards B. Thus, the latter part of A will be modified and altered by B, at the same time that it will a little modify or alter it, till at last it be quite overpowered by it and end in it."—*D. Hartley.*

nous, or contiguity in time and contiguity in space.[1] In the former the one impression occurs after the other, and when recalled they come up in the same order, the one recalling the next in succession to it. Thus, the first suggests the second, and the second the third, and so on. We cannot reverse the order, or proceed from the third to the second and the second to the first without great difficulty, if at all, unless we have practised it.[2] Thus, it is easy to repeat the alphabet in the order in which we have learnt it, but it will be found to be extremely difficult to repeat it in the reverse order, beginning at the end. *Sermo* may recall speech, and speech *sermo*, because they have been presented to the mind in both ways; but if the order was for speech always to follow *sermo*, then the word speech would hardly suggest *sermo*. Thus one may be able to translate freely from a foreign tongue into English, but if he has not also practised translating into that language or speaking it, he will be little able to do so.

It is on this principle of association by successive contiguity that verbal memory depends, and those in whom this faculty is strong, or who have greatly cultivated it, can perform great feats in this way, being able to repeat long passages of a book after having once read them, or a speech or a sermon from once hearing it. As a rule, however, they cannot single

[1] "Contiguity of two sensations in time means the successive order. Contiguity of two sensations in space means the synchronous order."—*Jas. Mill.*

[2] "It is easy to repeat familiar sentences in the order in which they always occur, but impossible to do it readily in an inverted order."—*D. Hartley.* "In a poem, the end of each preceding word being connected with the beginning of the succeeding one, we can easily repeat them in that order, but we are not able to repeat them backwards till they have been frequently named in that contrary order."—*Dr. Priestley.*

out a particular passage or sentence, and repeat it by itself; for each succeeding part depends for its recall on that which immediately preceded it, so that it is only by beginning at the commencement, and repeating till they come down to it. that they can recall any particular passage.[1]

In synchronous contiguity, or contiguity in space, a number of things are presented to the mind at the same time, but differing in position and distance from a particular point, as the various objects in a landscape.[2] These are not observed in any definite order, the mind, as it were, passing to and fro among them in every direction, and therefore they may be recalled in any order, or the whole may be brought up simultaneously.[3] From this we have local memory, in which the sight, or the idea of a place, tends to recall various objects or incidents that have been associated or connected with it in the mind.

Association by contiguity is the first to come into exercise, and is also the strongest form of association. The memory, therefore, that depends upon it is of great strength. Children are remarkable for having this kind of memory in great vigour, as we see in the facility with which they learn words, and to repeat long pas-

[1] "Let us suppose that we have forgotten the tenth verse of the first Book of the Odyssey of Homer. Because the tenth verse usually occurs to us after the first nine, we begin to be moved by thinking of the first verse, after which the second occurs, then the third, &c., till after the ninth verse the tenth occurs, and thus we recollect the tenth verse, which we had forgotten."—*Aristotle.*

[2] "The second is the order of position when the objects are considered as simultaneous, but different in distance and direction from a particular point."—*Jas. Mill.*

[3] "The relation of coexistence is distinguished from the relation of sequence by the readiness of its terms to follow one another through consciousness in either order with equal facility and vividness."—*H. Spencer.*

sages by rote.[1] We also find it very strong in persons in whom the higher form of association,—that by similarity,—is undeveloped, as in ignorant persons and those that are of weak intellect. These, as we have seen, sometimes manifest a very remarkable strength of verbal or local memory. It is on this principle of contiguity that mnemonical systems are constructed, as when what we wish to remember is associated in the mind with a certain object or locality, so that, when we see or think of the object or locality, the ideas associated with it will at once come up; or when each word or idea is associated with the one immediately preceding it, so that when the one is recalled the other comes up along with it, and thus long lists of names or long passages of a book can be readily learnt by heart.

It is of the utmost importance that we strive to develop and cultivate this faculty in early life, when it is most susceptible of cultivation. This is necessary not only for itself, but also because association by contiguity enters largely into the higher form of association by similarity,—for the similars require to be brought together in order to be associated, and unless the power of association by contiguity be strong, that by similarity will be defective.

The great principle to be observed in association by contiguity is to bring the sensations or ideas two and two together before the mind, each with the one immediately following it, and fixing the attention upon them, so that the two become as one. The concentration of

[1] "It is surprising to what a degree of culture our power of retaining a succession even of insignificant sounds is susceptible. . . . This susceptibility of memory with respect to words is possessed by all men in a very remarkable degree in their early years, and is indeed necessary to enable them to acquire the use of language."—*D. Stewart.*

the attention is as necessary here as we have seen it to be in forming the mental impression. "We cannot," says Dr. Pick, "too strongly insist on the importance of completely isolating each couple of ideas at the moment of comparing them, and confining our attention solely to them, until the comparison be made throughout the series."

As a general rule, the more closely the ideas that we wish to associate together are brought together in the mind the more strongly will they cohere, and the greater will be their power of reproducing each other. If an interval takes place between the one idea and the other in being presented to the mind, there is ever a tendency for irrelevant ideas to spring up between them, and interfere with their cohesion.[1]

When the mind has experienced a number of different sensations, when it has come to possess a number of different ideas, then a new principle of association is introduced,—the new sensation or idea recalls past sensations or ideas of the same kind which are brought up and compared with it, and so they become associated together in the mind.[2] The principle of association is still contiguity, but it is not contiguity depending merely upon proximity in time or place, but arising from similarity. The similars may be widely

[1] "In carrying out the principle of association it will be found that if one idea is not quickly and very closely connected with another, and an interval takes place, be it ever so slight, there is a tendency of irrelevant ideas to spring up in the mind interfering with those which it is desired to connect."—*Anon.* "The rapidity and strength with which two given notions stick together is in the inverse ratio of their phrenotypic distance . . . by which I mean the time that elapses between the two notions that are to be connected together acting upon the brain."—*Major Beniowski.*

[2] "The law of similarity . . . expresses the general fact that any present state of consciousness tends to revive previous states which are similar to it."—*Dr. Carpenter.*

apart in space or in time, but they are brought together and associated through their resemblance to each other. Thus, a circumstance of to-day may recall circumstances of a similar nature that occurred perhaps at very different times, and they will become associated together in the mind, so that afterwards the presence of one will tend to recall the others.

It is of the utmost importance to us in forming a judgment of things, or in determining upon a particular line of conduct, to be able to bring together before the mind a number of instances of a similar kind, recent or long past, which may aid us in coming to a right determination.[1] Thus, we judge of the nature or quality of an article, and obtain light and leading in regard to any subject that may be before us. In this way we arrange and classify, and reason by induction and deduction. This is known as rational or philosophical association.[2]

If there were no other principle of association than that of contiguity, then each individual thought or impression would depend for its recall on that which immediately preceded it, and, in order to recover it, it would be necessary to begin at the beginning of the series, and retrace our course till we reached it.[3] When, however, association by similarity comes into operation, then our ideas become linked together according to their resemblances, so that if we wish to recall something that is in the mind, and cannot do so

[1] "It is exceedingly important in science and in the business of life that like should recall like."—*Prof. Bain.*

[2] "Rational or philosophical association is when a fact or statement on which the attention is fixed is associated with some fact previously known, to which it has a relation, or with some subject which it is calculated to illustrate."—*Dr. Carpenter.*

[3] "If to reach a distant recollection it were necessary to traverse the entire series of intervening terms, memory would be impossible, because of the length of time required for the operation."—*Th. Ribot.*

directly, we seek for something bearing some resemblance to it, and in this way we recover it.

Over the associations formed by contiguity in time or space we have but little control. They are in a manner accidental, depending on the order in which the objects present themselves to the mind. On the other hand, association by similarity is largely put in our own power, for we, in a measure, select those objects that are to be associated, and bring them together in the mind. We must be careful, however, only to associate together such things as we wish to be associated together, and to recall each other; and the associations we form should be based on fundamental or essential, and not on mere superficial or casual, resemblances.[1] When things are associated by their accidental and not by their essential qualities, by their superficial and not by their fundamental relations, they will not be available when wanted, and will be of little real use.[2] When we associate what is new with what most nearly resembles it in the mind already, we give it its proper place in our fabric of thought. By means of association by similarity we, as it were, tie up our ideas in separate bundles, and it is of the utmost importance that all the ideas that most nearly resemble each other be in one bundle.

[1] "The habit of correct association—that is, connecting facts in the mind according to their true relations, and to the manner in which they tend to illustrate each other . . . is one of the principal means of improving the memory, particularly that kind of memory which is an essential quality of a cultivated mind—namely, that which is founded not upon incidental connections, but on true and important relations."—*Dr. Abercrombie.*

[2] "In a mind where the prevailing principles of association are founded on casual relations among the various objects of its knowledge, the thoughts must necessarily succeed each other in a very irregular and disorderly manner, and the occasions on which they present themselves will be determined merely by accident."—*D. Stewart.*

When our ideas are associated together in the mind according to their resemblances, they can be recalled when and as they are required. To a mind so stored when thinking on any subject, those ideas that are most nearly connected with it, and most likely to throw light upon it, will come up.[1] Such a mind will not be harassed or distracted by the springing up of alien or irrelevant thoughts, for only such will present themselves as have a direct bearing upon the subject.

The wrong association of ideas in the mind is a source of endless mischief.[2] "The connection in our minds of ideas, in themselves loose and independent of one another," says John Locke, "has such an influence, and is of so great force, to set us awry in our actions, as well moral as natural, passions, reasonings, and notions themselves, that, perhaps, there is not any one thing that deserves more to be looked after." It is particularly in early years, and in the education of the young, that we must guard against wrong associations. "From the intimate and almost indissoluble combinations which we are thus led to form in infancy and early youth may be traced many of our speculative errors . . . many perversions of our moral judgment, and many of those prejudices which mislead us in the conduct of life."—*D. Stewart.* "We should never suffer any ideas to be joined in their (*i.e.*, children's) understanding in any other or stronger combination than what their own nature and correspondence give them."—*John Locke.*[3]

[1] "In consequence of this law of our nature . . . when an occasion occurs which calls for the aid of our past experience, the occasion itself recalls to us all the information upon the subject which that experience has accumulated."—*D. Stewart.*

[2] "Ideas that in themselves are not at all of kin, come," by chance or custom, "to be so united in some men's minds that it is very hard to separate them".—*John Locke.*

[3] "In the case of right belief the association is between ideas

"In reference to the whole science of education," says Dr. Abercrombie, "nothing is of greater importance than the principle of association.[1] . . . By means of a judicious education, this susceptibility of the infant mind (to form associations) might be rendered subservient not only to moral improvement, but to the enlargement and multiplication of our capacities of enjoyment."

In order to the formation of right associations in the minds of children there is no method more suitable than that of asking them questions—not, as is usually done at present, in order to find out what they know, still less to puzzle them about what they don't know, or know only imperfectly; but for the purpose of unfolding their minds and teaching them to lay up their knowledge in a natural and regular way. This should be done *viva voce*, and not from books, the questions springing naturally out of the child's answers, and being as nearly as possible in its own words,—a principle of similarity guiding the whole. Socrates, Plato, and others among the ancients, and some moderns, have been masters of this art.[2] The principle of asking

which, in the language of Locke, 'have a natural correspondence and connection one with another'; in the case of wrong belief, it is between ideas which, 'in themselves, are not at all of kin, and are joined only by chance or custom'."—*James Mill.* "All the differences, moral and intellectual, observable in human character, are only differences in the order of mental sequences,—that is, of the order in which the thoughts and feelings succeed each other in the individual mind."—*B. Cornelius.*

[1] "This habit of . . . association ought to be carefully cultivated, as it must have a great influence on our progress in knowledge, and likewise on the formation of intellectual character, provided the associations be made upon sound principles, or according to the true and important relations of things."—*Dr. Abercrombie.*

[2] In proposing questions it is very necessary to keep in view the importance of . . . arranging them in the exact order in which the subject would naturally develop itself in the mind of a logical and

questions and obtaining answers to them may be said to characterise all intellectual effort. The child makes its first entrance into the field of knowledge by asking questions, and the crowning efforts of the philosopher are still asking questions and attempting to find answers to them. The great thing is to ask the right questions and to obtain the right answers.

When association by similarity comes to be more and more the habit of the mind, association by contiguity becomes weaker—the simple process of connecting each following sensation or idea with the one just past is interfered with, and a new principle is introduced. When the mind is occupied in seeking among its past experiences for similars to something that is now present, it cannot give the same attention to what immediately preceded. Hence men of learning and culture are commonly said to have bad memories, but this is only because their ideas are associated on a different principle from those of the less educated.[1]

These two laws of association by contiguity and similarity have so much in common that it is not to be wondered at that attempts have been made to reduce

systematic thinker."—*Dr. Fitch.* "This art of questioning possessed by Dr. Hodgson was something wonderful and unique, and was to the minds of most of his pupils a truly obstetric art. He told them little or nothing, but he showed them how to find out for themselves. 'The Socratic method,' he said, 'is the true one, especially with the young.'"—*Life, by Prof. Meiklejohn.*

[1] "The bulk of mankind, being but little accustomed to reflect and to generalise, associate their ideas chiefly according to their more obvious relations . . . and above all according to the casual relations arising from contiguity in time and place; whereas in the mind of a philosopher ideas are commonly associated according to those relations which are brought to light in consequence of particular efforts of attention, such as the relations of cause and effect, or of premise and conclusion." Hence "it must necessarily happen that when he has occasion to apply to use his acquired knowledge, time and reflection will be requisite to enable him to recollect it".—*D. Stewart.*

them to one leading principle.[1] The first attempt of this kind was made by Augustine, who reduced them both to coexistence—thoughts that had once coexisted in the mind being afterwards associated together. Sir William Hamilton adopts the same view, and names it the law of "redintegration" or "totality," explaining it by saying that "those thoughts suggest each other which had previously constituted parts of the same entire or total act of cognition". It includes "in the first place those thoughts which arose at the same time or in immediate consecution; and in the second those thoughts which are bound up into one by their mutual affinity". "By this one law," he adds, "the whole phenomena of association may be easily explained."

The law of association prevails not only in our thoughts and sensations, but also in our actions, one action becoming associated with another, and tending to recall it. Thus the acquired movements of a soldier or of a skilled workman are so connected together that the one succeeds the other as it were of necessity,—the various movements are "so firmly associated that when

[1] Aristotle reduced the laws of association "to four, or rather to three—contiguity in time and space, resemblance, and contrariety. He even seems to have thought they might all be carried up into the one law of coexistence. Aristotle implicitly, St. Augustine explicitly—what has never been observed—reduces association to a single canon, viz., thoughts which have once coexisted in the mind are afterwards associated. This law, which I would call the law of Redintegration, was afterwards enounced by Malebranche, Wolf, and Bilfinger, but without any reference to St. Augustine."—*Sir W. Hamilton.* "Both (Hartley and Condillac) agree in referring all the intellectual operations to the association of ideas, and in representing that association as reducible to the single law, that ideas which enter the mind at the same time acquire a tendency to call up each other, which is in direct proportion to the frequency of their having entered together."—*Sir Jas. M'Intosh.* Dr. Thomas Brown is of opinion that "all suggestion may be found to depend on prior coexistence, or at least on such proximity as is itself very probably a modification of coexistence".

we will to do the first, the rest follow mechanically and unconsciously".—*Prof. Bain.* We have already stated (p. 245) that we do not consider this as a distinct form of association, depending merely on physical causes, but that the associated movements are owing to the presence of corresponding ideas which exist and form their associations in that ultra-conscious region of the mind in which so many of our highest mental operations are carried on. Thus even our mechanical habits depend on the association of our ideas.

But while we hold that all our physical associations have their mental side, we are likewise of opinion that all our mental associations have their physical side.[1] As every thought that passes through the mind is attended by motion and change in our physical structure, the associations that are formed between these thoughts must likewise have corresponding physical changes attending them. Hence it is, in our opinion, that we find so close a resemblance between the law of attraction in the physical world and the law of association of ideas in the mental.[2] The latter may perhaps be said to depend on, or at least to derive its character from, the law of attraction which pervades all matter.[3]

[1] "Two ideas will cohere feebly or strongly according as the correlative nervous states involve a feeble or a strong discharge along the lines of nervous connection; and hence a large wave of feeling, implying as it does a voluminous discharge in all directions, renders such two ideas more coherent."—*Herbert Spencer.*

[2] "It is neither an inapt nor a strained comparison to call this power (association by similarity) the law of gravitation of the intellectual world."—*Prof. Bain.* Hume calls it "a kind of attraction which in the mental world will be found to have as extraordinary effects as in the natural, and to show itself in as many and as various forms".

[3] "One may expect that vibrations should infer association as their effect, and association point to vibrations as its cause."—*Dr. D. Hartley.*

It is by means of association that we recall to mind past ideas and sensations. This is evident in those cases where we cannot at once recall a past idea, but have, as it were, to search for it, which we do by endeavouring to bring to mind something that occurred at the same time, or something that bears some resemblance to what is wanted. In the higher form of memory, where what is wanted occurs readily, naturally, and at once, without any conscious effort or search for it, the place of association is not so apparent, but there can be little doubt that here too it operates, though as a rule we are not conscious of it.

In order to fix a thing in the memory we must associate it with something in the mind already, and the more closely that which we wish to remember resembles that with which it is associated, the better is it fixed in the memory, and the more readily is it recalled.[1] If the two greatly resemble each other, or are not to be distinguished from each other, then the association is of the strongest kind.[2] In like manner, feelings of the

[1] "The remembrance of isolated facts does not depend merely on the degree of attention directed to them, but also on the existence in the mind of subjects of thought with which the new fact may be associated."—*Dr. Abercrombie.* "The facility of retaining a new fact or a new idea will depend on the number of relations which it bears to the former objects of our knowledge."—*D. Stewart.* "The more relations or likenesses that we find or can establish between objects, the more easily will the view of one lead us to recollect the rest."—*Dr. Jas. Beattie.* "The greater the similitude and the more numerous the points of resemblance, the surer is the stroke of recall. . . . In reading a poem the memory is assisted to remember it by all the similarities of thought, of imagery, of language, of metre and rhythm that one is able to evoke from the traces of former readings and recollections."—*Prof. Bain.*

[2] "Two objects completely similar, or which determine undistinguishable impressions upon us, are as if they were identical."—*Sir W. Hamilton.* "In the case of perfect identity between a present and a past impression, the past is recovered and fused with the present instantaneously and surely." "To whatever extent one thing

same order cohere more readily and surely than feelings of different orders.[1] Hence the importance of having the mind well stocked with materials with which to associate what we wish to remember. Each faculty and each division of a faculty is more or less limited. There are only a certain number of distinct acts that it is capable of performing, a certain number of separate impressions that it can receive, and hence if we train each to a due and accurate performance of all these acts, store it with all these impressions, then we have, as it were, a graduated scale of objects or ideas with which to associate whatever we wish to remember. Thus there are only a certain number of distinct sounds that the tongue can utter, and if it is taught to utter each of these distinctly, so as to have a distinct impression of it in the mind, and be able to recall it at will, then every new sound, every new utterance, would at once find its proper place, form its right association, and be remembered and recalled at will.[2] The same is

is the repetition of another, the cost of contiguous acquisition is saved."—*Prof. Bain.*

[1] "Feelings of different orders cohere with one another less strongly than do feelings of the same order. The impressions which make up the visual consciousness of an object hang together more firmly than the group of them does with the group of sounds making up the name of the object."—*H. Spencer.* "We can more easily think of the whiteness and figure of a lump of sugar at the same time than the whiteness and sweetness of it."—*E. Darwin.* "The relational element of mind . . . is greater between feelings of the same order than between feelings of one order and those of another. This answers to the fact that the bundles of nerve fibres and clusters of nerve vesicles belonging to feelings of one order are combined together more directly and intimately than they are with the fibres and vesicles belonging to feelings of other orders."—*H. Spencer.*

[2] "It appears, then, that an analysis and scale of articulate sounds, with minute description of the organic actions required to produce them, like the scale which we possess for music in the *gamut* and rules for fingering, should give nearly the same assistance to the speaker which the gamut gives to the player. . . . The modifica-

true with regard to the other senses and the mental faculties generally. The memory is able to retain and reproduce a vastly greater number of ideas if they are associated or arranged on some principle of similarity than if they are presented merely as isolated facts.[1] It is not by the multitude of ideas, but the want of arrangement among them, that the memory is burdened and its powers weakened.

Where two ideas that are very dissimilar are wished to be associated we may by means of analysis find parts of one closely resembling or identical with parts of the other, and by means of these may associate them. Thus words having certain letters or syllables the same tend to suggest each other.

tions of voice easily made and easily distinguishable by the ear, and therefore fit elements of language, are about fifty in number, but few languages use more than about half of them."—*Dr. N Arnott.* "Of late years physiologists, especially Brücke, have actually undertaken to draw up a complete system of all the vocables that can be produced by the organs of speech, and to base upon it propositions for a nuniversal alphabet adapted to all human languages."—*Helmholtz.* "All human utterances may be resolved into elementary sounds; and all the varieties of elementary sounds in different languages are the result of definite mechanical adjustments of the organs of speech. The organs are the same in all men, and, consequently, every man possesses naturally the ability to speak any or every language."—*A. M. Bell.* Mr. A. M. Bell has invented a system of characters, thirty-four in number, by which every variety of sound is accurately represented, and by the aid of which "different readers are enabled to place the organs of speech so as to yield with readiness and uniformity the minutest varieties of articulate sounds". "It will stand the following test: Let any sound, of which the human organs of speech are capable, be pronounced in his hearing, and he will engage to write it on paper, so that one who knows the characters shall be able to imitate the sound correctly at sight, though he has never heard it before, and has no other means of guessing what it was like."

[1] "The ignorant man may be said to have charged his hundred hooks of knowledge, to use a rude simile, with single objects, while the informed man makes each support a long chain to which thousands of kindred and useful things are attached."—*Dr. N. Arnott.*

CHAPTER IX.

MEMORY: HOW TO IMPROVE IT.

"The natural as opposed to the artificial memory depends on the relations of sense and the relations of thought,—the spontaneous memory of the eye and the ear availing itself of the obvious conjunctions of objects which are furnished by space and time, and the rational memory of those higher combinations which the rational faculties superinduce upon those lower. The artificial memory proposes to substitute for the natural and necessary relations under which all objects must present and arrange themselves an entirely new set of relations that are purely arbitrary and mechanical, which excite little or no other interest than that they are to aid us in remembering. It follows that if the mind tasks itself to the special effort of considering objects under these artificial relations, it will give less attention to those which have a direct and legitimate interest for itself."—*Dr. N. Porter.*

"By an artificial memory is meant a method of connecting in the mind things difficult to be remembered with things easily remembered, so as to enable it to retain and recollect the former by means of the latter. . . . One important objection applies to all of them, that they accustom the mind to associate ideas by accidental and arbitrary connections."—*D. Stewart.*

"The defect of most methods which have been devised and employed for improving the memory lies in the fact that while they serve to impress particular subjects on the mind, they do not render the memory, as a whole, ready or retentive."—*Dr. M. Granville.*

"Surely an art of memory may be made no more destructive to natural memory than spectacles are to eyes."—*Thomas Fuller.*

"The extent of the memory depends, first, on the daily use we make of it; secondly, on the attention with which we consider the objects we would impress upon it; and thirdly, on the order in which we range our ideas."—*Helvetius.*

"This is the faculty that most of all concerns us in the work of education. . . . All improvement in the art of teaching depends on the attention that we give to the various circumstances that facilitate acquirement or lessen the number of repetitions for a given effect."—*Prof. Bain.*

"The whole art of education as respects this faculty consists in regulating the reception of first impressions so as to give them the firmest hold on the mind; and in furnishing methods by which the power of recollection, in dependence on the will, may best be guided and maintained."—*Sir H. Holland.*

THAT the memory is capable of indefinite improvement there can be no manner of doubt; but with regard to the means by which this improvement is to be effected mankind are still greatly in ignorance.

Numerous books have indeed been written on Arts of Improving the Memory, and various schemes have been devised with that object, but they are all based on partial or erroneous views of the true principles of memory, and are, therefore, of little or no real value, tending rather to distort than to improve and strengthen the memory. Any means that are adopted for the improvement of the memory must be based on an intimate knowledge of its true nature, and the principles on which it acts.

We have distinguished three kinds or degrees of memory,—the local, the rational, and the representative or imaginative. The first of these depends upon locality, or objects that appeal to the sight, which have great power in vividly impressing the mind, so that whatever is associated with them is easily remembered. It is on this principle that systems of Mnemonics are usually constructed.[1] Most persons must have observed that when in a locality where they had been before, things that had happened then come very vividly before them. "In passing along a road," says D. Stewart, "which we had formerly travelled in the company of a friend, the particulars of the conversation in which we were then engaged are frequently suggested to us by the objects we meet with. In such a scene we recollect that a particular subject was started, and in passing the different houses, and plantations, and rivers, the arguments we were discussing when we last saw them recur spontaneously to the memory." Taking advantage of this principle, then, we may connect what we wish to remember with certain localities, the public

[1] "Locality is the most efficacious medium of recollection; and that system of memory will be the most serviceable which brings this principle into the most extensive operation. For that reason *locality*, or the connection of our ideas with places, is made the foundation of the present system."—*G. von Feinaigle.*

buildings of a town, the houses of a street, or the furniture of a room, and, by going over these actually or in imagination, the ideas associated with them will readily come up. Cicero, Quintilian, and others of the ancients practised and recommended this plan.[1] "By those who would improve the memory," says Cicero, "certain places must be fixed upon, and of those things which they desire to keep in memory symbols must be conceived in the mind and ranged, as it were, in those places; thus, the order of places would preserve the order of things, and the symbols of the things would denote the things themselves; so that we should use the places as waxen tablets and the symbols as letters." Quintilian recommends persons "to fix in their minds places of the greatest possible extent, diversified by considerable variety, such as a large house, for example, divided into many apartments. Whatever is remarkable in it is carefully impressed on the mind, so that the thought may run over every part of it without hesitation or delay." They are then to distinguish what they wish to remember by some symbol, by which they may be reminded of it. The symbols are then arranged in their proper order in the different parts of the house, or on articles of furniture. "Places," he says, "we must have either fancied or selected, and images or symbols which we may invent at pleasure.

[1] "There can scarcely be anyone of so acute a memory that he can retain the order of words and sentences without observing and associating them with material objects; nor, on the other hand, is there anyone of so dull a memory as not to receive aid from the use of this plan . . . those things being most fixed in the mind which have been given to it and impressed upon it by sense."—*Cicero.* "The memory is assisted by *localities* impressed upon the mind . . . for when we return to places after an absence of some time, we not only recognise them, but recollect also what we did in them; persons whom we saw there, and sometimes even thoughts that passed within our minds recur to our memory."—*Quintilian.*

These symbols are marks by which we may distinguish the particulars which we have to get by heart."

The modern system is to select a number of rooms, and to divide the walls and floor of each, in imagination, into nine equal parts or squares, three in a row. On the front wall—that opposite the entrance—of the first room are the units, on the right hand wall the tens, on the left hand the twenties, on the fourth wall the thirties, and on the floor the forties. Numbers 10, 20, 30, and 40 each find a place on the roof above their respective walls, while 50 occupies the centre of the roof. One room will thus furnish 50 places, and ten rooms as many as 500. Having fixed these clearly in the mind, so as to be able readily and at once to tell the exact position of each place or number, it is then necessary to associate with each of them some familiar object (or symbol), so that the object being suggested its place may be instantly remembered, or when the place is before the mind its object may immediately spring up. When this has been done thoroughly, the objects can be run over in any order from beginning to end, or from end to beginning, or the place of any particular one can at once be given. All that is further necessary is to associate the ideas we wish to remember with the objects in the various places, by which means they are readily remembered, and can be gone over in any order. In this way one may learn to repeat several hundred disconnected words or ideas in any order after hearing them only once.

Nearly allied to local is verbal memory, or memory by contiguity, in which by being strongly associated together, one word or one sentence will at once suggest the one next to it.[1] "The recollection of them," says

[1] "In what we call 'learning by heart,' which should be rather

Feinaigle, "is assisted by associating some idea of relation between the two; and as we find by experience that whatever is ludicrous is calculated to make a strong impression upon the mind, the more ridiculous the association is the better." In this way one may learn to repeat whole speeches verbatim, or long passages of a book after one reading, or a number of names or disconnected words from once hearing them. But he can repeat them only in the order in which they have been presented to his mind; and as each succeeding word or sentence depends for its recall on the one immediately preceding, he cannot, as a rule, recollect any particular part without commencing at the beginning and repeating down to it; nor can he readily transpose or omit portions.

All such systems for the improvement of the memory belong to what we have considered the first or lowest form of it. They are for the most part based on light or foolish associations which have little foundation in nature, and are hence of little practical utility; and they do not tend to improve or strengthen the memory as a whole. Lord Bacon long ago characterised such systems as "barren and useless". "For," said he, "immediately to repeat a multitude of names or words once repeated before . . . I esteem . . . no more than rope-dancing, antic postures, and feats of activity; and, indeed, they are nearly the same things, the one being the abuse of the bodily as the other is of the mental powers; and though they may cause admiration

called learning by sense . . . we try to imprint on our memory a certain sequence of words, numbers, musical notes, and the like; the reproduction of these being mainly dependent upon the association of each *item* with that which follows it, so that the utterance of the former, or the picture of it in the mind's eye, suggests the next."—*Dr. Carpenter.*

they cannot be highly esteemed." Another writer truly says of them: "The systems of mnemonics as taught are no better than crutches, useful to those who cannot walk, but impediments and hindrances to those who have the use of their limbs, and who only require to exercise them properly in order to have the full use of them".

The second kind of memory—the rational—likewise depends upon association, but of a very different kind from the former. In this the associations formed do not depend on locality, or on contiguity, but the ideas presented to the mind recall ideas of a similar kind in the mind already and become associated with them. The similarity or resemblance, between the ideas thus associated together, should not be merely superficial or fanciful, but be of an intimate or radical nature, and based on scientific or philosophical principles. "Sound logic," says Coleridge, "as the habitual subordination of the individual to the species, and of the species to the genus; philosophical knowledge of facts under the relation of cause and effect, . . . these are the best arts of memory."[1]

According to the associations that are formed among ideas is their power of recalling each other. When

[1] "Those things are easily remembered which are in order . . . but those which are not well arranged are with difficulty remembered."—*Aristotle.* "Whatever you would trust to your memory, let it be disposed in a proper method, connected well together, and referred to distinct and particular heads or classes, both general and particular."—*Isaac Watts.* "I am inclined to believe . . . that if we wish to fix the particulars of our knowledge very permanently in the memory, the most effectual way of doing it is to refer them to general principles." By means of general principles the mind "can summon up, as occasion may require, an infinite number of particulars associated with them, each of which, considered as a solitary truth, would have been as burdensome to the memory as the general principle with which it is connected".—*D. Stewart.*

ideas are associated together according to their leading or essential qualities, those that most nearly resemble each other will come up together, and will throw light upon each other. The more closely two ideas resemble each other, the more readily does the mind pass from the one to the other, and does the one suggest the other. If the two are identical, if what we wish to fix in the mind is exactly the same as, or not to be distinguished from, something in the mind already, then is the association of the strongest kind, the one is but a repetition of the other. The more there are of ideas of the same kind in the mind already, the more will there be of similar material for new ideas to be associated with, and the more easily will they be remembered. The medical man, or lawyer, has no difficulty in fixing in his memory any new facts that may come before him in connection with his profession, because he has in his mind already numerous facts of the same or a similar kind, among which the new facts find their proper place, and become associated with those they most nearly resemble.

In the cultivation of this kind of memory, Dr. Abercrombie recommends "the constant practice of tracing the relation between new facts and others with which we are previously acquainted; and of referring facts to principles which they are calculated to illustrate, or to opinions which they tend to confirm, modify, or overturn". Further, he recommends, in the education of children, to cultivate "habits of association, by pointing out to them the relation of facts to each other, and the manner in which they illustrate one another, or lead to some general conclusion".

This kind of memory is not, like the other, calculated to produce startling effects in a short space of time, or

to be mastered in a few lessons. It is of gradual growth, of universal application, and its effects are lasting.

These two kinds of memory depend, as we have seen, upon association, but association is properly only the means by which what is in the memory is recalled or brought again before consciousness, the subject-matter of memory, that which is treasured up and recalled is the impression made upon the mind itself by the sensation or idea, and unless this is clear and distinct that which is recalled will be imperfect.[1] In order then to a good memory, one that will bring the past clearly and accurately before us, we must attend to the formation of the original impression. When the impression that is formed in the mind is clear, distinct, and vivid, it will be readily reproduced with much of its original character and force ; but when, on the other hand, it is indistinct, hazy, or ill-formed, it will be recalled with difficulty, and only in a very imperfect manner.

The highest form of memory then regards the impression, and has to do with the means by which it may be made most clear and lasting.[2] We have termed it the "representative" or "imaginative memory," because by it past sensations or ideas are imaged forth, or presented to the mind as nearly as possible in their original form, as if they were again objects of actual perception. In place, then, of striving to fix a thing in the memory by associating it with something that is

[1] "Objects distinctly beheld are longest retained in the mind and most readily recalled."—*Paxton Hood.* "If we would treasure up the ideas of things, actions, propositions, arguments, and sciences, these should be recommended to our memory by a clear and distinct perception of them."—*Isaac Watts.*

[2] "The natural and only true basis of memory is a well-founded impression."—*Dr. M. Granville.*

more easily remembered, or with something in the mind already, we seek to strengthen the power of memory itself, so that it can readily seize upon whatever is presented to it, and by concentrating the attention upon it form a clear and distinct image in the mind, which can afterwards be recalled at will.

By noting what takes place when the original impression is first presented to the mind, we shall better understand the conditions most favourable to its recall. When, then, an impression is made upon an organ of sense, a form of motion, as we have seen, is set up in it, which is conveyed by means of connecting nerves to the brain, where it becomes an object of consciousness. In like manner, in order to the performance of a conscious voluntary act, a motion originates in the brain, and passes along connecting nerves to the muscles, which are thus brought into action. And as with sensation and muscular action, so with thought—every thought that passes through the mind producing motion in the part of the brain where it is seated. These motions effect changes in the material constituents of the parts where they take place, which changes are permanent, and form, in our view, the physical basis of memory.

The changes thus effected are not confined to the brain, but extend to all the other parts in which the motions took place, particularly the organs of sense and the muscles. The effect of these motions—in other words, of exercise—upon a muscle, is well known. It increases in size, and becomes stronger and more fitted for the performance of its work,—each individual act doubtless contributing somewhat towards producing the total result. "This gain in size," says Dr. Hering, "consists not only in the enlargement of the individual

cells or fibres of which the organ is composed, but in the multiplication of their number; for when cells have grown to a certain size, they give rise to others which inherit more or less completely the qualities of those from which they came, and, therefore, appear to be repetitions of the same cell."[1] In like manner, when we exercise a sense, it acquires strength and delicacy in the direction in which it is exercised, which can only be by the physical organ acquiring additional power and fitness.[2] The eye daily employed in comparing and measuring distances and relations in space gains more and more in precision, doubtless through a growing adaptability in the visual organ. Speaking of the improvement of the sense of touch in the blind, Dr. Carpenter says: "This is doubtless to be in part attributed to the increased attention which is given to the sensations, and in part, it may be surmised, to an increased development of the tactile organs themselves, resulting from the frequent use of them". In all such cases the improvements that take place are not confined to the brain, but extend to the muscles or organs of sense concerned in them.

In every sensation, in every thought, as well as in every muscular movement, there is activity, and

[1] "How is it that new groups of cells are formed in accordance with the infinitely varied combinations of the muscles in all those numerous instances on which skill in art, work, habitual movements, or even writing and speaking, depend?"—*Dr. Laycock.* "The aptitude which is acquired by practice for the performance of certain actions that were at first accomplished with difficulty seems to result as much from a structural change which the continual repetition of them occasions in the muscle, as in the habit which the nervous system acquires of exciting the movement."—*Dr. Carpenter.*

[2] "That a continuous development of new nerve fibres takes place in the adult has been proved beyond question by facts demonstrated in many of the textures of man and the lower animals."—*Dr. L. S. Beale.*

memory may be said to be the remembrance of activities—of acts done in the body.[1] Every form of activity registers itself, as it were, in the particular part of the body in which the action takes place, and hence it comes to be more and more easily performed with each repetition.[2] The seat of the activity is also the seat of the memory of it, which is not the brain alone, but extends to the different parts in which the activity has taken place. Activities of the same kind take place and are registered in the same parts, and activities of different kinds in different parts, of the body.

Whatever tends to prevent the mind from acting upon the same parts as were concerned in the original impression is detrimental to its recall. Thus, emotion, passion, and other feelings that are of a diffusive nature, and affect the brain generally, prevent action along limited tracts.[3] Hence the apparent antagonism between our feelings and our intellect, the one acting, as it were, in direct opposition to the other. In order to the clear, unbiassed action of the intellect, we must put away feeling and passion. Owing to their diffusive nature, our past feelings are very difficult of recall, and we cannot reflect upon them with any degree of clearness.

[1] "The cultivation of every science and the practice of every art are in fact a species of action."—*Sir J. Mackintosh.* "Knowledge is not acquired by mere passive affection, but through the exertion of spontaneous activity on the part of the knowing subject."—*Sir W. Hamilton.*

[2] "The registering of experiences, it appears, is accomplished by a modification of the nervous structure, making the part affected more susceptible to a recurrence of the same movements which took place in the original stimulation. The greater the amount of force brought to bear in affecting the nerves, the more complete and permanent will be the modification, and hence the more indelible will be the registry."—*D. G. Thompson.*

[3] "Emotion spurns nice distinctions and incapacitates the mind for feeling them".—*Prof. Bain.*

When a sensation or a movement is recalled to mind in its highest form,—when it is imagined,—we believe that the same parts are affected, and the same kind of motion takes place as in the original impression, but in a reverse order,—the recalled sense-motion commencing in the brain where the idea originates, and terminating in the organ of sense, and the recalled muscular motion commencing in the muscles and terminating in the brain. In order to this we have attempted to prove that, contrary to the received opinion, each class of nerves is capable of conveying impressions both to and from the brain,—that afferent nerves, while primarily conveying impressions from the organs of sense to the brain, are also capable of conveying impressions from the brain to the organs of sense, and, in like manner, that efferent nerves, while they primarily convey impressions from the brain to the muscles, likewise carry impressions from the muscles to the brain. We cannot suppose that a different class of nerves would be employed in the recollection of a sensation or a movement from what was originally concerned in producing it.

That the organs of sense and the muscles are concerned in this highest form of memory has also been attempted to be shown. The artist who can recall and paint a scene from memory must be able to bring its various features very vividly before his mind's eye. The calculator who can carry out long and intricate processes of calculation mentally, does so, we are told, by having in his mind's eye something resembling a black board, on which he has the power of making the figures appear and disappear at will.[1] In these and the

[1] "I have had occasion to note that several calculators do not see the figures in their problems, but *hear* them. It matters little, so far as our theory is concerned, whether the images are visual or auditory."—*Th. Ribot.*

like cases the mind's eye can be no other than the bodily one, on the retina of which the impressions are mentally imaged. All objects of sight impress themselves upon the retina, and we believe that all mental visual impressions imprint themselves there and nowhere else. And as with sight, so with hearing, touch, taste, smell, and muscular feeling.[1] When we recall a movement or a series of movements very completely, we seem to be actually going over them again, not only in idea in the brain, but in the nerves and muscles, so that "in mentally recalling a verbal train, we seem to repeat on the tongue the very words; the recollection consists of a suppressed articulation".—*Prof. Bain.* The fact of example being more powerful than precept may, perhaps, find its explanation here, for when we see a thing done we are in a measure doing it ourselves, because we are mentally going over the different steps of the process one by one.

But in our view the senses are concerned not only in the recalling of our sensations, but also of our ideas. Every idea in the mind must have entered it by some sense, and in order to its full and complete recall, we believe that it must be again projected or imaged in an organ of sense. Even the most abstract of our ideas are abstracts of sensations belonging to some sense which is also concerned in the recollection of them. In every act of knowledge we distinguish between the subject knowing and the object known,—between the thinking *Ego* and the object about which we think. In all right thinking we must clearly distinguish between the two, and hold up the object in the clear, steady,

[1] "It is probable, if not certain, that the renewed feeling or idea occupies the same parts, and in the same manner, as the original or actual feeling."—*Th. Ribot.*

concentrated light of consciousness. "Thought," says Heyse, "is not even present to the thinker till he has set it forth out of himself."[1] "We cannot think," says Dr. Cunningham, "without thinking of something, and that subject must be thought of as outside the mind. It is not our thoughts, but the things we think of that are present to our consciousness; and thus our thinking consists of a series of visions." "In the act of estimating what is right in morals, or what is sound in reasoning, or what is correct in taste, we no more look to the mind than we do in the act of estimating what is true in geometry, or of estimating any of the properties of material substances."—*Dr. Chalmers.*

When a man thus puts forth the ideas in his mind they become, as it were, objects of sense,—things that he can see, hear, or handle. They are imaged or represented to the mind by the aid of some sense. The eye is the sense that is most frequently employed in this way, for it is usually a visual image that we endeavour to form of what we are thinking about.

Memory in our view, then, is not simply an intellectual faculty having its seat in the brain, but is, in a great measure, a sense faculty, including in its seat the senses, the voluntary muscles, and other parts of the body. A man remembers forms, colours, faces, places, &c., because his eye is naturally strong, and has been cultivated in that direction. When we cannot readily recollect something we wish to remember, we endeavour to recall its visual appearance, or to go back to the time or occasion when it was previously in the mind and an object of sense. It has frequently been remarked that

[1] "The intellectual operations always imply an externality; even where we are speculating about our own feelings or mental operatures, we always view them as if apart from ourselves."—*G. H. Lewes.*

those who are accustomed to deal with material objects, or are much in converse with nature, and have consequently their senses greatly exercised, have great powers of memory, and in the arrangement and expression of their thoughts.[1]

The object of memory is the impression or image which is formed in the mind, and this depends upon the clearness and accuracy with which it is taken up and apprehended by the senses. In proportion, then, as we train and cultivate any sense do we improve the memory of that sense, and as we improve the memory of a sense do we train and cultivate it. The perfection of any sense consists in its being able to perceive minute shades of difference, and in order to this a good memory is necessary,—one having a strong hold of past sensations.[2] And as with sensations so with muscular movements. We strengthen the memory of any set of movements by practising the movements, and the improvement that is effected through practice in the movements depends on the memory of past movements; when that is strong new acquisitions are easy.

There are three principal ways in which the mind receives its information, and treasures it up in the

[1] "One man in attempting to convey a notion of any object he has seen, seems to place it before him and to paint from actual perception; another, although not deficient in ready elocution, finds himself in such a situation, confused and embarrassed among a number of particulars imperfectly apprehended, which crowd into his mind without any just order or connection."—*D. Stewart.* "I have always remarked (and so have most people who have read any scientific work at all) the great power and command of language that is generally possessed by persons possessing high scientific attainments."—*Robt. Lowe.*

[2] "No law of the intellect appears to be more certain than the law that connects our discriminating power with our retentive power. In whatever class of subjects our discrimination is great—colours, forms, tones, tastes—in that class our retention is great."—*Prof. Bain.*

memory. These are by seeing, by hearing, and by speaking or acting. Some remember best what they see, others what they hear, and others what they say or do. There are many persons who do not remember much of what they see or hear, but they remember well what they say or do. This is particularly the case with children, and hence they usually learn their lessons best by repeating them aloud. What is learnt by rote is of this nature. It is not by the eye or ear so much as by the muscular exertion of speaking that it is remembered. "We remember our vocal utterances," says Prof. Bain, "partly as connected threads of vocal exertion. . . . Our memory for spoken language is a mixture of articulate and auditory recollections." Writing with one's own hand what has to be remembered is a well-known aid to verbal memory. "The effect of this," says Prof. Bain, "is not simply to add a new line of adhesion—the arm and finger recollections, although we might remember by these,—but to impress the forms upon the eye through the concentrated attention of the act of copying." Mr. Stokes lays great stress upon written exercises, but it is mainly as addressed to the visual memory, so that the written words may be recalled as the printed words of a book. On this he bases a system of mental writing. "At first," he says, "the letters used in mental writing should be slowly and carefully formed and combined; but afterwards the speed should be increased, and ultimately whole words or sentences ready-made will appear instantly before the mind's eye at pleasure." There can be no doubt that our motor feelings and motor memory count for more in our mental phenomena than is commonly supposed. "Every conscious state," says Ribot, "depends to a certain extent upon motor elements."

In education, then, it is necessary to attend to the training of each of these kinds of memory; and in order to this they must be kept carefully apart, and each trained by itself.[1] When we wish to exercise the visual memory we must be careful not to call forth the auditory or muscular memories, nor with the motor memory should the forms or even the sounds be awakened. The sounds will, doubtless, in some measure, be present, and guide the vocal utterances, but it should be, as it were, unconsciously,—the attention being concentrated mainly on the movements, and one movement calling forth another. In order to train the auditory memory, the pupil should have the matter read or repeated to him till he has taken it in by the ear; in order to learn by sight he must take in the words by the eye, and form visual images of them, and to learn by means of the vocal organs he must have recourse to reading or repeating aloud.

The first requisite to a good memory,—to the formation of clear and lasting impressions,—is sound physical health, with all the functions of the body going on easily and naturally.[2] When the body is fresh and vigorous, plentifully supplied with sound arterial blood, impressions are easily made, and are usually lasting.

[1] "A common error into which beginners are apt to fall is to try to combine, and therefore confuse, the two methods of remembering by sight and by sound. They should be kept carefully apart."—*Dr. M. Granville.* "The initial and prevailing difficulty in teaching language in general and the mother tongue in particular is due to the doubleness of the acquisition—the union of language and thought . . . and the attention is divided between the two factors instead of being concentrated upon one to the neglect of the other."—*Prof. Bain.*

[2] It is "obvious that this organic mental faculty (*i.e.*, memory), as at present possessed even by the most highly favoured individuals, is susceptible of much enhancement and extension, merely by an improvement of the corporeal constitution".—*Isaac Taylor.*

When, on the other hand, the body is exhausted by fatigue or disease, or suffers from want of nourishment or impoverishment of blood, the impressions will be slight and made with difficulty.[1] In youth the body is easily impressed, and the impressions made are lasting,[2] whereas in old age impressions are formed with difficulty, and are also difficult of recall. The time to be chosen for exercise is when the physical powers are most active and vigorous. Whatever strongly excites the mind, or presents itself when the mind is under strong excitement, usually makes a lasting impression.[3] If the curiosity is strongly excited about a thing it readily fixes itself in the memory. As a rule the mind looks upon a thing with more interest, and its curiosity is more excited concerning it on its first appearance than on any subsequent occasion. Hence the first occasion of an impression reaching the mind is always the most favourable for fixing it in the memory.[4] Each

[1] "A normal exercise of the memory supposes an active circulation and blood rich in the materials necessary for integration and disintegration."—*Th. Ribot.* "Disturbance to the memory may arise from too feeble circulation through the brain as well as from over-excitement or congestion of blood there."—*Sir H. Holland.*

[2] "In youth memory is strong, for then our sensations are keen." —*Dr. Beattie.*

[3] "That is likely to be long remembered which, at its first appearance, affects the mind with a lively sensation, or with some pleasureable or painful feeling."—*Dr. Beattie.*

[4] "The sensations which affect us the most are those which we never before have experienced. The consequence is that in proportion as the same sensations are repeated the less impression do they make upon us, because the comparison between the present and the past becomes less sensible."—*Dr. Bichat.* "The surest and most effectual way to ensure an easy and accurate reproduction of ideas is to deal with the first impression. . . . Reproduction of ideas is mainly dependent upon the strength or vivacity with which the ideas primitively come to the mind, or, in other words, upon the first impressions which the mind receives. . . . Supposing the primitive ideas to have been strong and vivid, their reproduction will be easy, almost spontaneous."—*Dr. Pick.*

subsequent recurrence of it renders it more familiar to the mind, which is therefore less curious about it; and, besides, the repeated appearance of the same impression under different circumstances tends to diminish the clearness and distinctness of the original.[1]

In order to recall a previous impression or idea in the fullest and most complete manner possible, the same parts must be affected and the same kind of motion set up as when it was originally before the mind; that is, not only the brain but the nerve-fibres and the special organ of sense, or muscles traversed by the original movement, must again be acted upon. When the renewed motion is confined to the brain and does not extend to any of the other parts, the recalled impression is imperfect, and this is the character of the great majority of our remembrances. We are content with only a partial recall, in which none of the senses but only the brain is concerned. The reason why objects of sense make a stronger impression on the mind than ideas, is because the senses and the nerves are concerned in the former but not in the latter. Did we bring the

Most persons find "that the first image they have acquired of any scene is apt to hold its place tenaciously in spite of subsequent need of correction. . . . If they see an object equally often in many positions, the memories combine and confuse one another, forming a composite blur which they cannot dissect into its components. They are less able to visualise the features of intimate friends than those of persons of whom they have caught only a single glance."—*F. Galton*. "A person who leaves a place, and who has consequently no later associations with which to obliterate the earlier ones, looks back through a clearer medium, so to speak, to a former period, and to the circumstances of where he then lived. In that direction of his thoughts nothing seems to stand between him and the distant object. To one, on the other hand, who has passed through a long series of events and social communications in the same neighbourhood, these would be found to occupy and crowd the latter part of the retrospect so much as possibly to render the remoter circumstances much less distinct."—*John Foster.*

senses and the nerves to act along with the brain in the recalled impression, there is every reason to believe that it would be equally clear and distinct with the sensation.

In order to effect this, and to attain the highest form of memory, we must cultivate the faculty of imagination, or the power of holding up to the mind past sensations or impressions, as if they were again actually present to us. We can retain the impression of an object in the mind for some time after the object itself has passed away by allowing the mind to dwell upon it, and we can afterwards readily recall it. If I lay an object, say my watch, upon the table and look at it intently for a few seconds, I shall find on shutting my eyes that I still retain a more or less distinct image of it. I may even, after a considerable time, be able to recall the image of the watch, and the exact spot where it lay. If, in place of one, I take three or four or half-a-dozen different objects and arrange them on the table, I can, after contemplating them for a short time, imprint a mental image of them in the mind, and can afterwards recall them with great distinctness. By practice we may largely increase the number, and may also imprint them with great readiness, so that they can afterwards be recalled with accuracy.[1]

The French conjuror, Robert Houdin, many of whose tricks depended on the remarkable powers of memory he and his son had acquired, relates in his *Autobiography* that they would "pass rapidly before a toy shop, or any other displaying a variety of wares, and cast an attentive glance upon it". A few steps

[1] "A useful faculty, easily developed by practice, is that of retaining a retinal picture. A scene is flashed upon the eye; the memory of it persists, and details which escaped observation during the brief time when it was actually seen may be analysed and studied at leisure in the subsequent vision."—*F. Galton.*

farther on they took paper and pencil from their pockets, and tried which could describe the greater number of objects seen in passing. In this, we are told, the son excelled the father, for he could often write down forty objects, while the latter could scarcely reach thirty; and yet they rarely made a mistake. We cannot suppose that in the brief glance they cast on the shop in passing they were able to see and individualise thirty or forty different articles. We can only account for it by supposing that, in that brief glance, they took, as it were, a photograph of the shop in question, and with this in the eye before it vanished, they jotted down on paper as many of the articles as they could distinguish. Should they afterwards have occasion to recall this shop they would do so by reviving the photograph in the eye, and from this they would be able to recount the various articles more readily and certainly than by any other mode of committing to memory. "That power of memory," he says, "which my son possessed in an eminent degree, did us the greatest service. When we went to private houses he needed only a very rapid inspection in order to know all the objects in a room, as well as the various ornaments worn by spectators, such as chatelaines, pins, eye-glasses, fans, brooches, rings, bouquets, &c. He thus could describe these objects with the greatest ease when I pointed them out to him by our secret communication." An instance is also given in which he saw at a glance and remembered the titles of many of the books in a library he passed through in a house in Paris.

Nor was this great power of memory a natural gift, but was acquired by great application. M. Houdin commenced to teach his son by taking "a domino, the cinq-quater for instance, and laid it before him. In-

stead of letting him count the points of the two numbers, I requested the boy to tell me the total at once. 'Nine,' he said. Then I added another domino, the quater-troy. 'That makes sixteen,' he said without any hesitation. I stopped the first lesson here; the next day we succeeded in counting at a single glance four dominoes, the day after six, and thus we at length were enabled to give instantaneously the product of a dozen dominoes." This result obtained, they proceeded to apply themselves to more difficult tasks.

In this way one may soon learn to remember all the cards that have been played in a game of whist, which mere playing for a lifetime may fail to teach him. Let him begin by throwing down four cards one by one upon the table, observing each by itself and the order in which it is laid down, as well as the whole together, till he feels that he has learnt them. Let him then take them up, and after a time replace them as they were before from memory, and this till he feels that he has thoroughly mastered them. For a second lesson let him take first four cards and treat them in this way, and then other four; and let him proceed in this way, always increasing the number till he can take in the whole pack, and tell of each card when and where it was thrown down. That mere playing may never teach a man this is owing to the attention being taken up with the play and not sufficiently directed to this operation.

In systems of mnemonics we are taught to remember figures by means of letters which are formed into words, —words being generally more easily remembered than figures. But if the eye is properly trained there is no more difficulty in remembering figures than words or letters, and it may be done with infinitely less trouble.

Commence with two or three figures on a black board or slate, regard them attentively for a short time, so that they may be well impressed on the retina, then rub them out, and afterwards restore them from memory. Let the number of figures be gradually increased in subsequent exercises, and in a short time one will find no difficulty in fixing in the mind large sums or a number of dates by simply looking at them. Care should be taken not to name or pronounce any of the figures, because, in so doing, we distract the attention by bringing into exercise other forms of memory,—the auditory or the muscular,—whereas, at present, we wish only to train the visual. And as with figures, so with names, words, sentences, and the like. We believe it to be possible by practice to photograph, as it were, on the retina page after page of a book by simply glancing over each, and to afterwards repeat their contents word for word, as if reading them from the printed page. "The scholar," says Richter, "when he reflects . . . really seems to read a printed page; and when he speaks to give a little declamation out of a quickly and well-written pamphlet."

And as with sight, so with the other senses of hearing, feeling, tasting, and smelling. We cultivate the imaginative faculty in each and all of them by training the mind to dwell upon the original impression, and to recall it in its entirety afterwards. We can retain the impression of a sound upon the ear for some time after it has passed away, and by cultivating this power we can subsequently recall any sound we have heard with great accuracy. The like is true of our muscular movements: by going over them step by step mentally we can afterwards readily recall them. In all these cases the principle at work is the same,—it is the calling again into action of the parts that were concerned in the

original sensation or movement, and our training should be directed to this end.

Education is the great means by which the memory is made either good or bad. Nothing can do more for its improvement than a rightly conducted system of education, and nothing can do more to injure it than one wrongly conducted. Unfortunately our present day education partakes more of the latter than the former. We may say of memory what the authors of the Port Royal Logic say of reason,—we employ it "merely as an instrument for acquiring the sciences, whereas we ought to avail ourselves of the sciences as an instrument for perfecting our memory". The great business of education should be the cultivation of the memory, for upon this everything else depends. By means of it we develop and instruct the intellect, build up the moral character, and even train the physical powers. "The leading inquiry in the Art of Education," says Prof. Bain, "is how to strengthen the memory."

It may well be questioned whether the great powers of memory displayed by young children are not subsequently lost mainly through wrong methods of teaching.[1] When a child first sees a thing it takes

[1] "At the age of six years a child will learn the common words of a language in less than twelve months if he hear it continually spoken; which, as he acquires the pronunciation and accent as well as the meaning, is a proof not only of quick memory, but also of an exact ear and of great flexibility in the organs of articulation. . . . As we advance in life the acquisition of languages becomes more and more difficult; the talent of remembering new words decays gradually, nor is the ear so quick in catching a foreign accent, or the organs of speech so pliable in articulating unusual sounds."—*Dr. J. Beattie.* A child ten years old, "by dint of a succession of efforts of observation, imitation, and repetition, at very short intervals contrives both to understand and to speak a foreign language in a few weeks. This twofold process baffles an adult, because . . . he tries rather to understand than to reproduce what is spoken."—*T. Prendergast.*

it in by the eye, when it first hears a thing it takes it in by the ear; in each case the whole mind is concentrated upon the sensation, which, as Dr. Carpenter says, "is the natural state of the infant". But as soon as its education begins all this is changed, and the mind, in place of being concentrated upon one thing, is distracted by several.[1] We have said that in order to impress a thing clearly and accurately upon the mind, we must contemplate it by itself, for the mind cannot be in two places or engaged in two operations at the same instant of time; further, that it passes more readily and easily from one object to another of the same kind than from one to another of different kinds,—from one object of sight to another or one sound to another, than from an object of sight to a sound, or a sound to an object of sight. These ought to be leading principles in every rightly conducted system of education, but, unfortunately, they are almost totally ignored. To take the earliest, and what should be made the simplest and easiest, process to the child, that of learning the alphabet, we have three distinct operations,—we have the form of each letter to be apprehended by the eye, the sound to be taken up by the ear, and the pronunciation to be mastered by the tongue. In the ordinary way the child is expected to carry on these three operations at one and the same time, and hence none of them is efficiently performed, for when the mind is attempting to apprehend the form it cannot give sufficient attention to the sound, nor to the form when attending to the sound, nor to

[1] "The methods of education should recognise the wise arrangement of nature in developing and maturing the memory. In the earlier periods of life the spontaneous memory should be stimulated and enriched by appropriate studies."—*N. Porter.*

either when taken up with the pronunciation.[1] Instead of this the child's ear should first of all be accustomed to the sounds of the different letters, arranged not in their alphabetical order, but according to their sounds, beginning with the simplest, even before he attempts to utter them.[2] There can be no doubt that children learn much by the ear in infancy before they can speak or utter articulate sounds.[3] Then, as a next step, let him be taught to repeat accurately the different sounds as he hears them; and only when he can do this perfectly should he be made acquainted with the forms of the different letters. Thus, the sounds of the different letters will be clearly and accurately imprinted on the ear, and the different forms on the eye, while the vocal organs will also have learnt their correct pronunciation.

After the alphabet the child should be taught to pro-

[1] "Why thould he (*i.e.*, a child) be troubled with the form of the letters till once he has acquired the sound of them? Why should he be taught to read before he is taught to speak?"—*John Herries.*

[2] J. Brinsly, in his "*Ludus Literarius*, or the Grammar School" (1612), dwelling upon the importance of the child acquiring a correct pronunciation of each letter, says: "This may be done, and also the teaching of children to spell any syllable before the child do know any letter on the booke, and that some wise and experienced do hold the surest and best course". Pestalozzi says: "When I had begun to teach reading I found out, after a while, that my pupils wanted first to be taught speaking," and this led him to begin with teaching pronunciation. Before his pupils were taught reading, or even the alphabet, he exercised them in articulating not only the elementary sounds of the language, but also their most difficult combinations, until they could pronounce them easily and correctly. "Sound is the leading element in language both spoken and written. We hear the words even when we see them, but we do not see them when we hear them. The visible symbols are accessory and subordinate. But to the born deaf the visible symbols dominate."—*G. H. Lewes.*

[3] "It is notorious that children and animals are affected by our voices when quite incapable of understanding the meaning of our words."—*G. H. Lewes.*

nounce single syllables, and then words of two or three syllables. In imparting a correct pronunciation, the words chosen should be such as convey no connected meaning to the mind, for the meaning tends to withdraw the attention from the sound; and hence children learn unmeaning words and phrases much sooner than such as have meaning. On this account some recommend the taking the words of a sentence backwards. "The object in taking the words in backward order," says C. W. Smith, "is to disassociate them from their sense as connected with the sentence, so that the student can . . . give his entire attention to the mere utterance of the words instead of being wholly or partly occupied with the meaning or feeling of the language."[1] In this way a correct pronunciation is acquired at first in place of a faulty one which has afterwards to be corrected. In order that the ear may form correct impressions of sound, the child should be read to before he attempts to read himself; and as the ear and not the eye is the proper guide to the tongue, he should be accustomed to repeat from having read or repeated to him.[2] Spelling, on the other hand, should be taught

[1] "The pupil should be able to concentrate his attention entirely upon the mechanism of the matter, instead of having his mind partly or wholly directed to the language, as it should be in reading or reciting passages."—*C. W. Smith.* "It would, of course, be more amusing to recite connected than unconnected words, as it is more amusing to sing passages than single notes; but as assuredly no singing voice ever yet was formed by the exclusive utterance of anything that could be called music, so no speaking voice will ever yet be formed by the exclusive utterance of anything that can be called literature."—*John Hullah.*

[2] "There is reason to believe that the incitations which evoke speech start primarily from the auditory word centre."—*Dr. Bastian.* "The misleading principle of governing the voice by forms of language has done much to hinder the progress of elocutionary science."—*A. M. Bell.* "As to him that learns from another person who reads to him . . . after he has heard a passage once or twice, he may immediately

not orally but visually, by accustoming the eye to the appearance of the words.[1]

In teaching a foreign language, the method usually adopted is so contrary to the principles we have been endeavouring to lay down, that it may be said to be "the way not to do it". It seems mainly designed to give the teacher as little to do as possible, and the pupil as much as possible. The ear is the organ that should be chiefly employed in the learning of a foreign language,—the ear to take up the sounds when spoken, and to guide the tongue in speaking.[2] But in place of teaching by the ear, it is much easier for the master to teach by the eye,—making the pupil read books, learn grammar rules, and turn up words in a dictionary.[3] A language learnt simply from books can never be used with any degree of readiness, for the words present themselves as they appear to the eye in place of as they

begin to try his memory and attempt to rival the reader."—*Quintilian.* In reading aloud, "if we are not accustomed to it, the sound of our voice and the fear of going wrong, will withdraw our attention and prevent remembrance".—*Dr. J. Beattie.*

[1] "Spelling should never be taught orally. It is required for writing,—only for the eye; and it should therefore (at this early stage) be taught only by dictation."—*Sonnenschein and Meiklejohn.* "The memory for spelling lies more in the eye than in the ear; the orthography of words is associated less with the sounds of their component letters than with the pictorial aspect of the verbal combinations as a whole."—*A. M. Bell.*

[2] "All languages both learned and mother tongues be gotten, and gotten solely, by imitation. For as ye use to hear, so ye learn to speak."—*R. Ascham.* "By far the shortest way to learn to read a language is to begin by speaking it. The colloquial tongue is the basis of the literary tongue."—*P. G. Hamerton.*

[3] "Languages are then spoken in greatest perfection when all rules of grammar are utterly forgotten."—*John Locke.* "A dictionary causes grievous interruption to the trains of thought, besides involving loss of time, uncertainty, misdirection, and confusion . . . and it ought never to be resorted to when a native is at hand, or when a translation is available."—*T. Prendergast.*

strike the ear.[1] "Languages," says John Locke, "are only to be learnt by rote . . . so that having thought of the thing he would speak of, his tongue, of course, without thought of rule or grammar, falls into the proper expression and idiom of that language." But a language learnt by means of a grammar and the application of grammar rules is not learnt by rote, but by a process of reasoning, which is also called into operation in selecting the proper words in a dictionary; from which, as Ascham says, he "learneth first an evil choice of words, then a wrong placing of words, and lastly, an ill-framing of sentences, with a perverse judgment both of words and sentences".[2] "Hence," as Milton says, "we spend seven or eight years in merely scraping together as much miserable Latin and Greek as might be learnt otherwise easily and delightfully in one year."

In learning a foreign language the ear of the pupil should first of all be familiarised with the different sounds even before he attempts to utter them, still more before seeing them in print. If the sounds are once mastered by the ear it will guide to the correct pronunciation of them, after which the association of them with their appropriate letters and words will be a matter of little difficulty. For the learning of languages it is of the utmost importance to have an ear well trained to distinguish and retain every variety of sound, and vocal organs capable of giving them accurate expression.

[1] "To understand a language by the eye and by the ear are distinct attainments . . . and a person who reads a dead language fluently and with accuracy may be incapable of understanding it otherwise than very imperfectly when spoken."—*Dr. Somerville.*

[2] The less reasoning that is brought to bear upon the sounds when they are first uttered for imitation, the better chance will there be of success."—*T. Prendergast.*

Mezzofanti is said to have possessed a retentive memory, a quick ear, and an incredible flexibility of the organs of speech.

The Prendergast system of teaching languages proceeds very much upon the plan we advocate, except that it does not make the training of the ear a distinct process, as we are inclined to do. At the outset a certain number of sentences are "committed to memory one by one very perfectly from the teacher's voice, without seeing their symbols on paper or even imagining their spelling". "Every sentence of a new language," he says, "must be regarded as an indivisible, inseparable combination, until the memory has grasped it securely. . . . No clause or phrase is to be analysed, or even divided into words, until an easy and correct utterance of the whole of its combined sounds has been obtained."[1] A translation may then be received of each word, but the learner must not ask for the nominative case, or the root or any other variety of any word. "There must be no hesitation in the delivery; but the learner must be prompted whether he likes it or not, whenever a word does not come instantaneously to his

[1] "The construction of the sentence being studiously concealed from him . . . he does not know which of the new sounds, or how many of them, belong to each word, and he can form no idea of the meaning of any one syllable. This ignorance is his safeguard in respect to pronunciation; for if he understood the words he would infallibly employ the peculiar intonation, the accents, the cadences, and the emphases of his own language, because they have become habitual to him." The beginner must keep "his reasoning powers in abeyance, and his imagination under control, until he can utter the first sentence with a good intonation, as if it were only one long word. . . . The memory and the understanding have so little given them to do, that the attention may be concentrated on the pronunciation."—*T. Prendergast.* "The less you understand of a language, the more sensible you are to the melody or harshness of its sounds." —*T. De Quincey.*

lips." To hesitate or to doubt leads to reason and reflection, which are hostile to memory. Afterwards he is to practise new varieties of sentences with the aid of a paradigm, or table of inflections, prepared so that the eye may command at one view the whole of the terminations of all the variable parts of speech. Subsequently he is to read some foreign book with a native, with the aid of a translation,—the learner reading out from the translation a clause or short sentence to the native, whose business it will be to read aloud in return the corresponding foreign words,—the pupil following the reader's course with the eye, and carefully echoing the tones of his voice, not word by word but clause by clause. These principles will be understood when it is borne in mind that the mind is differently placed in acquiring sights, sounds, vocal movements, and intelligible ideas, all of which are included in learning a language.[1]

In learning to write there are two distinct operations to be mastered. There are the forms of the different letters to be impressed on the eye, and the copying of them to be effected by the hand.[2] In place of carrying on these two operations together the eye should first be familiarised with the forms of the different letters, and afterwards they should be written not from a copybook but from dictation—not from examples before the eye,

[1] "Kussmaul says: 'If we consider memory as a general function of the nervous system, there must be, for the combination of sounds into words, at once an acoustic memory and a motor memory'. Memory of words is thus double: (1) there is a memory for words, as far as they may be regarded as groups of acoustic phenomena; (2) there is another memory for words, as motor images."—*Th. Ribot.*

[2] "When we learn to write we fix the eyes upon a copy; the visual signs are registered in the brain, and then, with great effort, we learn to reproduce them by movement of the hand. . . . We are able to write only when the visual signs are translated immediately into movements."—*Th. Ribot.*

but from impressions formed in the memory.[1] It might be well, too, that the hand be trained to perform the various movements that are involved in writing before actually beginning to write.[2]

In the teaching of arithmetic Mr. Bidder laid great stress upon having the actual numbers vividly impressed upon the mind in place of the mere symbols of them. To this he attributed his wonderful power of mental calculation, and expressed his strong conviction that most children, if taught in this way, might achieve similar results.[3] We are told that before he was six years old, when he was sent to school, and when he did not know the common numerical symbols, he was accustomed to amuse himself by arranging peas, marbles, or the like in rows and squares of different numbers, and by counting them over to ascertain the results of the combinations. Thus 8 rows of 8 = 64, 10 rows of 10 = 100. Hence the figures did not present themselves to him merely as symbols, but they represented to his mind an equal number of definite

[1] "There is reason to believe that the incitations which evoke writing movements start primarily from the visual word-centres."—*Dr. Bastian.*

[2] "No person is prepared to begin to write until the hand, arm, and fingers have been so trained or drilled that they have become perfect instruments of the will for the purpose of executing all the movements involved in writing. All the time given before that ability is attained, to practise after copies, is time very unprofitably passed, and is calculated to confirm the worst of habits in the use of the pen."—*A. Maclaren.*

[3] "I have for many years entertained a strong conviction that mental arithmetic can be taught as easily, if not even with greater facility than ordinary arithmetic, and that it may be rendered conducive to more useful purposes than that of teaching by rule ; that it may be taught in such a way as to strengthen the reasoning powers of the youthful mind—so to enlarge it as to ennoble it and render it capable of embracing all knowledge, particularly that appertaining to the exact sciences."—*G. P. Bidder.*

objects. He never went beyond 100. In this way he taught himself the values and relations of the actual numbers, and acquired a marvellous facility in dealing with them. He could multiply a row of fifteen figures by another row of the same number, and give the actual result in a few minutes without seeing or writing down a single figure.

"Till a man has had considerable practice, there are," says James Mill, "few acts of the mind more toilsome" than "the addition of a long column of numbers";[1] and yet, if properly learnt, there is no reason why this should be the case. If we analyse the operation of addition, we find that it consists in bringing together two sums and associating them with a third sum. Thus, 6 and 7 are 13; 13 and 6 = 19; 19 and 9 = 28; 28 and 6 = 34; and so on. Now, if we concentrate the attention upon each of these groups by itself, and associate them together in the mind, so that afterwards, whenever the two former occur, the third, being their sum, will at once come up; and if we treat every association of units with units, or units with tens, in the same way, then one may sum up a whole column of figures almost at sight. This is best done by simply using the eye without naming the figures. That we fail in being able to do this now is owing to the fact that the two sums are not sufficiently associated in the mind with the third for the latter to come up at

[1] "The reason is that the names of the numbers which correspond to the different steps do not readily occur; that is, are not strongly associated with the names which precede them. Thus, 7 added to 5 make 12; but the antecedent 7 added to 5 is not strongly associated with the consequent 12 in the mind of the learner, and he has to wait and search till the name occurs. Thus, again, 12 and 7 make 19; 19 and 8 make 27, and so on to any amount; but if the practice of the learner has been small, the association in each instance is imperfect, and the process irksome and slow."—*Jas. Mill.*

once, but it is usually arrived at after a process of thought and, perhaps, of finger-counting. Let a man once learn thoroughly that 9 and 8 are 17, and he learns it for ever, but he will never learn it thoroughly if he immediately adds and 6 = 23, and 7 = 30. The mind must dwell upon the one set of figures, and thoroughly master it before proceeding to the next.

In learning by heart we usually attempt to master too much at once, and hence the impressions formed in the mind lack clearness and distinctness. The better way is to take only a few words at a time, perhaps only two or three, so as to have little difficulty in fixing them clearly in the mind, then a few more, being careful to confine the attention to the words immediately before it.[1]

Probably there is nothing more hurtful to the memory than the system of cramming that so largely characterises the education of the present day. "Cramming," says Prof. Bain, "is a scheme for making temporary acquisitions regardless of the endurance of them," and "is extremely unfavourable to permanent acquisitions". The analogy evidently is, as Dr. Carpenter says, "to the overloading of the stomach with a mass of food, too great to be digested and assimilated within a given time, so that a large part of it passes out of the body without having been applied to any good purpose in it". "Everyone is aware," he continues, "that what is rapidly learnt . . . is very commonly

[1] In committing to memory "it is proper that we dwell on every part till we have thoroughly acquired it before we proceed to any other".—*Dr. Gerard.* "In learning a language the leading principle is to learn a very little at a time; not in a loose, careless way, but perfectly."—*T. Prendergast.* "A person ought at first to commit every word and syllable to heart whatever trouble it may cost him; for this will most speedily perfect the habit of remembering, and make it more easy for him to remember afterwards."—*Dr. Gerard.*

forgotten as quickly, one set of ideas driving out another." "Individuals often remember clearly and well up to the time when they have to use their knowledge, and then, when it is no further required, there follows a rapid and extensive decay of the traces."—*B. Verdon.*[1]

Learn to trust the memory, and, in order to trust it, strive to make it worthy to be trusted.[2] It grows in trustworthiness by being trusted. "By trusting his memory, even though it oftens fails him, and by giving himself up with undivided attention to what he would remember, any person may increase his powers of memory to any degree." Sir Philip Warwick says of Lord Stratford: "His memory was great, and he made it greater by confiding in it".

All doubting, suspecting, questioning, of the memory should be avoided as being highly prejudicial to it. "Spoil not thy memory," says Thomas Fuller, "with thine own jealousy, nor make it bad by suspecting it. How canst thou find that true which thou wilt not trust?" Dr. Adam Clarke relates, in his *Autobiography*, that when a young man in a shop, soon after his conversion, he became possessed with the idea of asserting nothing of whcih he was not absolutely certain, and the result was that he lost certainty of any-

[1] Dr. Abercrombie gives the case of a distinguished actor who was called, on a few hours' notice, to take a part that was entirely new to him. "He acquired it in a very short time, and went through it with perfect accuracy, but immediately after the performance forgot it to such a degree that, though he performed the character for several days in succession, he was obliged every day to study it anew. Characters which he had acquired in a more deliberate manner he never forgets, but can perform them at any time without a moment's preparation."

[2] "Learn to trust your memory and not be always viewing it with suspicion."—*W. Stokes.* "The memory should be brought to such a condition by exercise that one may never learn to excuse its failures."—*Quintilian.*

thing. If asked if he had done such a thing, or gone such a message, he would reply that he thought he had, but he was not sure, perhaps he hadn't. In fact, his memory became utterly useless for any practical purpose. No reliance could be placed on it either by himself or others. "He either forgot to do what he was ordered, or forgot when he had done it . . . and wondered to find the work done which he had been sent to execute, though himself a little before had been the agent." "He prayed much, immediately forgot that he had prayed, and went to prayer again." It was only after a lengthened period of careful exercise that he was able to overcome this weakness, but his memory never came to be what it was before, though he afterwards rose to eminence.

It not unfrequently happens that the more a person endeavours to recall a thing, the more it seems to elude his grasp. The very effort to recover it seems rather to drive or keep it away.[1] In such a case there should be no attempt to force the memory, or to keep it on the subject, for this only injures it.[2] It will be more likely to recur to us if we turn the attention to something else. "If," says Hartley, "the desire (to recollect a thing that has escaped us) be great it changes the state of the brain, and has an opposite effect, so that the

[1] "We frequently experience, when we are doubtful about the spelling of a word, that the greater voluntary exertion we use, that is, the more intensely we think about it, the farther are we from regaining the lost association between the letters of it, but which readily recurs when we have become careless about it. . . . So in endeavouring to recall to our memory some particular word of a sentence, if we exert ourselves too strongly about it we are less likely to regain it."—*Dr. E. Darwin.*

[2] "Recollection—that is, the effort of the will to recover what is laid up in the memory—cannot be carried beyond a particular point without inducing a certain confusion of mind hurtful to the faculty itself, and probably to others also."—*Dr. Forbes Winslow.*

desired idea does not recur till all has subsided; perhaps not even then." "The first mistrust of memory," says Sir H. Holland, "leads many persons to tax it in the way of trial. . . . They persist in harassing efforts to recover a word, a name, or a number . . . whereas the labour of the attempt is in itself the cause of present failure, and of future mischief if often repeated. . . . The apprehension of inability actually creates it, and one failure begets another."

Further, in order to improve and strengthen the memory, we must be constantly exercising it.[1] We must be constantly supplying it with materials fitted for its use, and we must also be frequently calling upon it to produce its treasures, so that we may know exactly what they are and where to find them when they are wanted.[2] Hence we should be frequently reviewing the past, day by day, week by week, year by year; reviewing every book we read, every conversation we hear, every act we do.[3] Infinite injury is done to the

[1] "If anyone ask me what is the only and great art of memory, I shall say that it is exercise and labour. To learn much by heart, to meditate much, and, if possible, daily, are the most efficacious of all methods. Nothing is so much strengthened by practice or weakened by neglect as memory."—*Quintilian.*

[2] "The habit of frequently reviewing the information we possess . . . is the most effectual of all the helps to memory that can possibly be suggested."—*D. Stewart.* "The frequent representations of the same objects to the memory are, in a manner, so many touches of the graver, which cuts them deeper in proportion to the frequency with which they are represented."—*Helvetius.*

[3] "It was an excellent advice which an ancient philosopher gave to his scholars at the end of every day, to recollect all the actions of it, that if they had done anything amiss they might amend it next day, and that if they had done anything well they might enjoy the comfort of it."—*Dr. A. Gerard.* "After reading as much as you can easily retain, be careful always to reckon up the facts or items that you have gained. If imperfectly remembered, turn back and refresh the memory."—*Anon.* "It is a good plan to imagine always that you will be required to give a full description of that which you see and hear."—*W. Stokes.* A character in one of Mr. C. Reade's

memory by the habit of loading it with matter that is seldom or never recalled. This, is unfortunately, the character of much of the reading of the present day, which has for its object merely the satisfying of a momentary curiosity, after which the subject is perhaps never again thought of, and speedily passes entirely from the mind.[1] The evil habit thus induced rapidly extends to more important matters, and much that it is wished and desired to retain is found to slip away from the memory,—its entire character comes to be undermined, and little reliance can be placed in it for any-

novels says: "My mother . . . taught me three rarities—attention, observation, and accuracy. If I went a walk in the country, I had to bring her home a budget: the men and women on the road, their dresses, appearance, countenances, and words; every kind of bird in the air, and insect and chrysalis in the hedges, the crops in the fields, the flowers and herbs on the banks. . . . Another time mother would take me on a visit: next day, or perhaps next week, she would expect me to describe every article of furniture in her friend's room, and the books on the table, and repeat the conversation—the topics at all events."

[1] "Most people read merely to pass an idle hour, or for something to talk about, or for their own immediate pleasure, without any attempt to impress the memory. Nothing in truth has such a tendency to weaken . . . the intellectual powers in general as a habit of extensive and various reading without reflection."—*D. Stewart.* "Tales, novels, and histories derive their greatest charm from the curiosity they excite, to know what will become of the hero or heroine."—*Dr. Laycock.* "I believe the habit of perusing periodical works may be properly added to Averroe's catalogue of anti-mnemonics or weakeners of the memory."—*S. T. Coleridge.* "She read whatever excited public attention and curiosity, but she read to little or no effect; she impatiently hurried over the volumes before her that she might begin something else; the consequence unavoidably was that in a very short interval she retained no recollection of the principal features, facts, and characters of the books she had recently perused."—*Anon.* "Few great men have not courage to be ignorant of an infinite number of useless things."—*Helvetius.* "'It requires courage indeed,' as Helvetius has remarked, 'to remain ignorant of those useless subjects which are generally valued;' but it is a courage necessary to men who either love the truth or who aspire to establish a permanent reputation."—*D. Stewart.* "If I had read as much as other men, I had been as ignorant as they."—*T. Hobbes.*

thing. Note-books and common-place books, however useful and necessary they may be to many of us, have certainly an injurious effect upon the memory, for one will be at little pains to commit to memory what he can readily find by turning to a note-book.[1]

[1] "It is said by Plato that the use of writing is detrimental to memory, because, as he intimates, what we have committed to writing we cease in some degree to guard and lose it through mere neglect." —*Quintilian.* "The bad effects of writing down those facts and events which we wish to remember" is that "they are taken down for future consideration, and consequently receive very little present consideration".—*Sydney Smith.* "It is certain that when we read with a view to fill up commonplaces, we are apt to attend rather to particular passages than to the scope and spirit of the whole; and that, having transcribed the favourite paragraph, we are not solicitous to remember it, as knowing that we may at any time find it in our common-place book."—*Dr. J. Beattie.* "In regard to memory, it is remarkable how much its power is increased, in many instances, by that kind of exercise by which it is alone trusted to, without any aid from writing."—*Dr. Abercrombie.*

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